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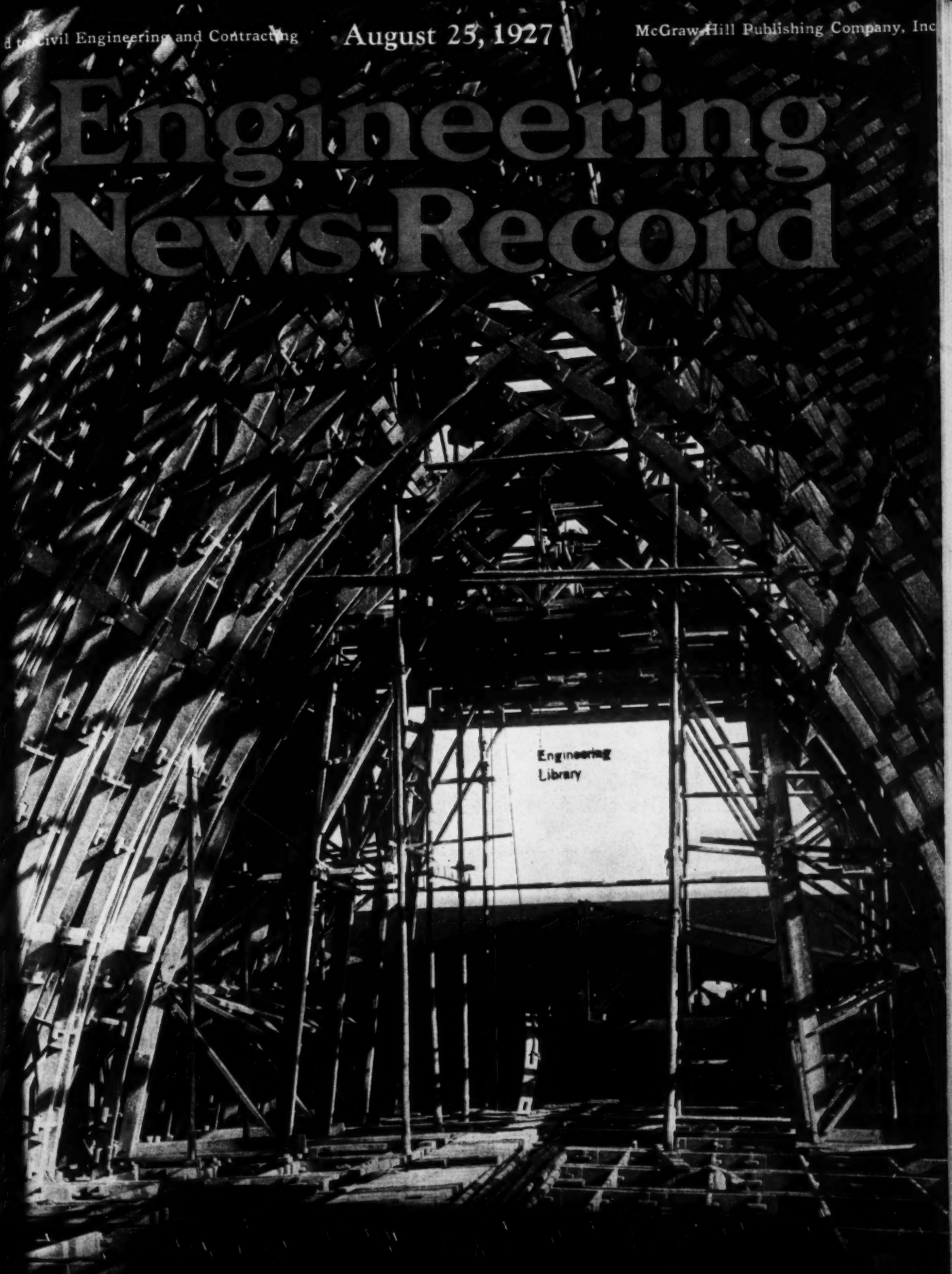
Engineering News-Record



Reinforced-Concrete Roof Framing
in Reconstructed Reims Cathedral

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FRANK C. WIGHT
Editor

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A Great Business Man

IT WILL be hard to think of the Steel Corporation without Judge Gary. So far as the public was concerned they were born together. And they were born in a troublous time when "big business" was beginning to strain at its proper bounds and to take on an aspect dangerous to the public good. Like most evil this tendency had its cure in itself, but the cure was hastened by the salutary example of the Steel Corporation, which, the way that corporation was constituted, meant the example set by Judge Gary. He believed in organization, a fair attitude toward labor, a fair treatment of the customer and a reasoned, not a cut-throat, competition. By steady and insistent application of these principles he developed his own business to unprecedented proportions and at the same time kept the price of his product within reasonable bounds and permitted the whole industry to grow along with his business. But what is more, he, more than any one individual in the last generation, modified first into forebearance and then into appreciation the widespread resentment of the Roosevelt era against the big manufacturing corporation. Judge Gary was not a technical steel man and some of his attitudes, especially his reluctance to abolish the twelve-hour day and to establish adequate research, suffered by that fact, but even in those two important reforms he lived to overcome his natural prejudices and to move forward. He was the outstanding figure in the first quarter of the twentieth century in American business—and that is no mean distinction.

Standard Concrete Roads

DISCONTENT is expressed by a correspondent whose letter is published in this issue with the continuing lack of uniformity in concrete roadbuilding practice. The letter combines a commendably clear and terse statement of conditions with sharp criticism of highway engineering for these conditions. As an exposition of facts the letter does not inform the practicing engineer of anything of which he is not already aware, nor will it, more than have previously recitals of variations, arouse him to greater effort toward standardization. The reason for these conclusions is that practicing road engineers will be inclined to believe logical standardization of practice has gone pretty far, even granting that standardization is wholly the possible accomplishment that our correspondent assumes it to be. However, taking for the moment merely the count of variations, it may be questioned whether it gives a true picture. On the contrary one is inclined to argue that concrete roadbuilding has proceeded far toward uniformity. Certainly roadbuilding, using the term comprehensively, is well on the road toward common practice. One has only to hark back to 1916 when federal aid first began to remark the progress. Truly enough this commonality of thinking and practice has developed more noticeably in administration, traffic accommodation, upkeep, financing and the broader problems of the public roads business than in the details of pavement structure but it has been observable everywhere. If our correspondent's count of variations today seems deplorable a count five years ago would have appeared appalling to a disciple of standardization. Despite the truth of every variation emphasized in the letter in this issue, concrete roadbuilding practice is now more nearly alike in essentials in all of the 48 states than it ever previously has been.

Not a Sporting Event

FLYING has made marvelous strides ahead this summer. Three trans-Atlantic flights testify to the mechanical efficiency of the modern airplane, especially its motor, and to the skill and courage of the men who make flying a business. But the California-Hawaii prize flight of last week shows all too plainly that there is danger in tying aviation too closely to personal and local advertising and of making what is really a serious business a mere sporting event. The United States government, through the Department of Commerce, is reported to have protested against the conditions of this contest, but in vain. Now that a half-dozen lives have been lost and thousands of dollars worth of time and equipment have been thrown away in searches for the lost aviators it is clear that this protest was valid and should have been heeded. Long distance oversea flying needs the most careful preparation and something more than an adventurous spirit. It should not be encouraged by such offers as the one made by Mr. Dole.

Cross-Connections Should Go

ABOLITION of any and all physical connections between approved public water supplies and other sources of water supply not approved as to sanitary quality, as provided in a proposed amendment to the State Sanitary Code of New Jersey, summarized in our current news pages this week, is a measure that deserves support by the engineers, health boards and municipal councils of that state. The policy accords with resolutions adopted by the State Sanitary Engineers, an organization of engineers, health departments and the U. S. Public Health Service, and approved by most of the water-works officials of the country. A resolution prohibiting cross-connections is already in effect in New Jersey, except for time extensions applicable only where standard double check valves are used. Manufacturers in New Jersey are trying to get this exception made permanent. It is to be hoped that the New Jersey board will back its chief engineer in his recommendations for the prohibition of cross-connections and all other physical connections with water supplies not approved as to sanitary character. So far as appears, the only objection to

the blanket provision comes from factory interests and even they are willing to provide double check valves. Protection of the public health, as we have repeatedly urged, demands going the whole figure. Consent to a requirement for a double check valve is an acknowledgment that check valves fail of their purpose. Two check valves merely cut the risk in half.

Experience with Ocean Outfalls

EXPERIENCE with sewer outfalls extending into the Pacific Ocean from the mainland of the southern part of California has shown the necessity for careful attention to the joints. An interesting variety of these, actual and proposed, appears elsewhere in this issue. It is worth speculating, however, whether ocean outfalls in other regions, American and foreign, have been so much smaller, shorter, or so much less exposed to strain than those in Southern California as to afford no precedent for design. Or have the joints failed elsewhere and the fact not been observed, or observed and ignored?

Utilizing the Colorado

HOWEVER much the conservatively minded or those with special interests—regional or commercial—at heart may discount the recent press dispatch from the presidential summer camp that Secretary Work sees approaching agreement on the proposed Boulder Canyon dam, the passage of time and the needs of water supply, water power and flood control all conspire to hasten the day when agreement will be reached among the seven states most directly concerned so the vast natural resources of the Colorado River may be utilized. Whatever the location may finally be, Los Angeles and perhaps other Southern California municipalities and thirsty agricultural lands have a growing urge for water from the Colorado. Only a few days before the news dispatch already mentioned flashed over the country William Mulholland, chief engineer Los Angeles bureau of water and power, gave the city council of Los Angeles "solemn warning" against annexing more territory to the city's 440 square miles of area until an additional water supply has been provided. All possible sources in the Owens River valley and other water gathering grounds of the city are in use, Mr. Mulholland said. So sure is the city the Colorado River must be tapped that over $100,000 has been appropriated for surveys in that direction. While the urgency of the case might push Los Angeles and the sister cities in the Southern California district to attempt the development of the Colorado without a seven-state agreement, the enterprise would be difficult—far more so than for New York City to go to the Delaware for water without waiting longer for a tri-state treaty, a plan summarized and commented on in our issue of Aug. 11. In both instances, and in numerous other, although much less urgent, cases, interstate co-operation is becoming more and more imperative and gradually the obstacles to it are giving way before the needs of millions of progressive Americans.

Keep Traffic Moving

NO GREATER development in methods of keeping highways open in winter has taken place in the last year or two than the very considerable substitution of drift prevention for strictly snow removal operations. In this issue an engineer, who has made winter maintenance a study, discusses drift prevention and snow removal principles and practices. Without deprecating removal work he emphasizes drift prevention. This stand is indicative of general practice. Maintenance engineers widely are turning to the snow fence as a means of reducing the work of the snow plow. Evidence and reasons need not be reviewed. It is worth while, however, to notice how closely the development of drift-prevention appliances lines in with the trend of snow removal practice as it has evolved from the first tentative operations of less than ten years ago. Almost at the start, departure was taken from the thought that clearing the road began with the ending of the storm. Instead, counter attack was started as soon as the wind and snow began their offensive. Quick mobilization of men and equipment were arranged for and scarcely had the first ranks of snowflakes begun to cover the pavement when the army of snow plows and shovelers began to sweep them back. The strategic fundamental laid down for snow fighting was: Prevent snow accumulation. It is exactly in conformity with this principle that drift prevention has developed. It is a defensive measure to keep snow off the roads as plowing and sweeping are offensive measures. Behind this principle is the broader principle that continuity of traffic is paramount. As winter maintenance was originally taken up to provide free traffic movement regardless of season, so snow removal methods have been devised to provide free traffic movement during as well as between storms. Keep traffic moving! has become as fully the slogan of the road maintenance official as it has long been the battle summons of the railroad official.

Concrete and Sentiment

IN THESE United States utility and economy are sober words. We lean heavily upon expediency and the possibility of commercial and personal profit. A commercial building is apt to be beautiful only so long as it yields dividends. A public building must, in the first analysis, serve useful ends in an efficient manner. Churches, too, designed though they may be in accordance with a prevailing domestic ecclesiastical architecture, must meet the comfort of the congregation. The reverence for old buildings, per se, is not on our conscience.

It is not difficult, then, to hazard a guess as to what reconstruction means would have been employed to restore our young-old notable structures, had they suffered near annihilation through shell fire as did scores of French edifices during the World War. But the ways of the older world are different. Edifices that are half the age of Christianity itself merit the highest sentimental consideration of a highly imaginative race. Man-made structures that have defied centuries of disintegrating influences are faithful guardians of a national pride. In that state of mind, then, one finds the explanation as to why certain French engineers designed as they did when the Reims cathedral, shell-torn and ravaged by fire, was reconstructed.

The historic value was the thing to be preserved, and Gallic reverence provided methods of rebuilding whereby historic value has been conserved through the medium of modern construction materials. It piques one's fancy o consider that a cathedral, which was almost a century

in the building and which is seven centuries old, has been reclaimed by the substitution of precast reinforced-concrete planking for the more inflammable timber members. But such is the story of Reims' reconstruction, outlined on page 292.

We might discuss at length the daring design of the French engineers in this comparatively new structural material, but we prefer to wonder at the spirit of a nation that goes about its reconstruction with such meticulous reverence.

Reorganizing Standardization

IMPORTANT movements are under way in the field of standardization. After six or seven years of existence the American Engineering Standards Committee is in active ferment. Reorganization is under discussion, which if carried far enough may bring about a complete change in the methods of standards-making in this country.

The movement has complex motives and factors. Its outcome cannot yet be foreseen. But at all events it seems to presage the scrapping of the central ideas around which the Standards Committee was built, and a reshaping of its activities on the European pattern instead of that hitherto believed best suited to American needs. The most significant of its effects is that the change would profoundly affect the status and activities of many technical and industrial societies, reason enough to make it of countrywide interest.

It will be recalled that the formation of the A.E.S.C., as it is usually called, was based on the claim that our technical progress lacked two important functions, which the new body would perform: first, co-ordination of existing standardization activities, and with it elimination of overlap and duplication—a great catchword in those days; and second, validation by an impartial reviewing authority of the standards drafted by more specialized organizations. This validation was declared to be a vital objective; a specialist organization, it was said, could not or would not give consideration to all affected or conflicting interests, and therefore would produce a partisan, not universally acceptable standard, unless its procedure were directed and the result given the stamp of impartiality by the A.E.S.C., who would establish it as an American Standard.

There were then in existence many organizations occupied with standards. Some of them included both makers and users of the commodities involved, as the American Society for Testing Materials; others were engineering societies, as the American Society of Mechanical Engineers; still others were industrial or commercial bodies, such as the National Electric Light Association and the Association of American Steel Manufacturers. Conditions differed from those in Europe, where industrial co-operation and the reduction of variety had been unpopular and almost absent. There, when the new needs of the modern industrial era made themselves felt no other course was open than to organize a central agency to plan, formulate and popularize standards. American conditions required neither new agencies of standardization nor a supervisory body. Even the co-ordination of conflicting attempts at dealing with the same problem was being worked out most successfully. But the example especially of the British Engineering Standards Committee, which had done much work toward lifting England's industries out of medieval chaos, was regarded as proof that some supreme headquarters body ought to be created here, and an adequate motive was discovered in co-ordination and validation. Accordingly the A.E.S.C. was formed, on the express principle that it would not make standards but would merely validate, and that it would be a delegate body, a committee of technical societies. As to scope, the term "engineering" in the title was held to define it sufficiently.

These two fundamental principles have lately been questioned. The A.E.S.C. has for some months been considering reconstituting itself as the American Standards Association, and enlarging its activities not only beyond the field of engineering, but also to include the making of standards as well as mere validation; it would continue to validate standards made by others, but would also go into the business itself. So far as we know, the societies which father the committee have not been asked about the intended nullification of parental authority, but no doubt they would readily agree, in the interests of all-round progress.

Under the proposed new form, then, the American system of standardization by technical specialist bodies would give way to the European system of centralized standardization. We say "give way" advisably; the two systems might exist for a time, but not for long. All organizations now at work in the field therefore face a changed future, in which their standardizing work will be reduced to the status of subcommittee work under the new association and their independent activities will be confined to their purely technical objectives.

But the success of the change is by no means certain; transplantation of overseas ideas sometimes fails. If the European plan should not succeed, and the new association should not draw to itself centripetally the bulk of standardization and simplification, the organization would lose much of the assets it now possesses by virtue of its validation functions. It would in effect die. This too would be a loss to our professional and industrial system and to the societies which have co-operated in the work of the A.E.S.C.

While calling attention to these impending changes it remains to say that some pressing causes lie back of the proposed change of system. The A.E.S.C. has had its disappointments. The importance of its work has not been demonstrated so strikingly as to carry conviction to those who would chiefly use the results—the great producing and consuming industries. The industries were therefore not quick in coming to the financial rescue of the organization when it was found that the contributions of the constituent societies did not suffice for its needs. This lack of interest possibly was strengthened by an unfortunate slowness in the work of the A.E.S.C., a slowness that has been variously attributed to lack of energetic, driving leadership, lukewarm interest of the participating societies, unsympathetic attitude of the affected industries, and other causes. It is the hope of those who framed the proposals for transforming the organization that the new Association plan would win the live support of industry. The correspondence of disease and cure is not apparent; the task of engaging industry's co-operation would seem to require something other than dropping the term engineering, taking up the detail work of standards-making, and substituting the name association for that of committee.

Concrete Used in Rebuilding Reims Cathedral

Precast Reinforced Members of Thin Section, Simulating Wood Unharmed in World War, Used for Varying Types of Roof Trusses—Original Lead Roof Re-employed

IN THE reconstruction of the Reims Cathedral, which was partially destroyed by shell fire and burning in the World War, and the restoration of which has just been completed, a method was followed whereby the former structural elements of wood were replaced by reinforced-concrete members. As much of the edifice as was found structurally sound was saved, and the concrete members were built to simulate the existing timber, thereby safeguarding to the greatest degree the historic character of the church.

Cathedral's History—The cathedral of Reims was commenced in the 13th century on the site of a church built near the year 400, was reconstructed from 820 to 860, considerably modified in the twelfth century, and destroyed by fire in 1210. A year later the first stone of the present cathedral was placed. Contrary to the procedure followed with a number of churches built at the same time, the original plans of the Reims Cathedral designer, Jean d'Orbais, were scrupulously followed so that the completed church presented a remarkable unity of style constituting one of the most faithful examples of thirteenth century Gothic architecture. The church was built of shell limestone supplied from neighboring quarries, and is of excellent quality, as has been demonstrated by its resistance to the heavy shell fire.

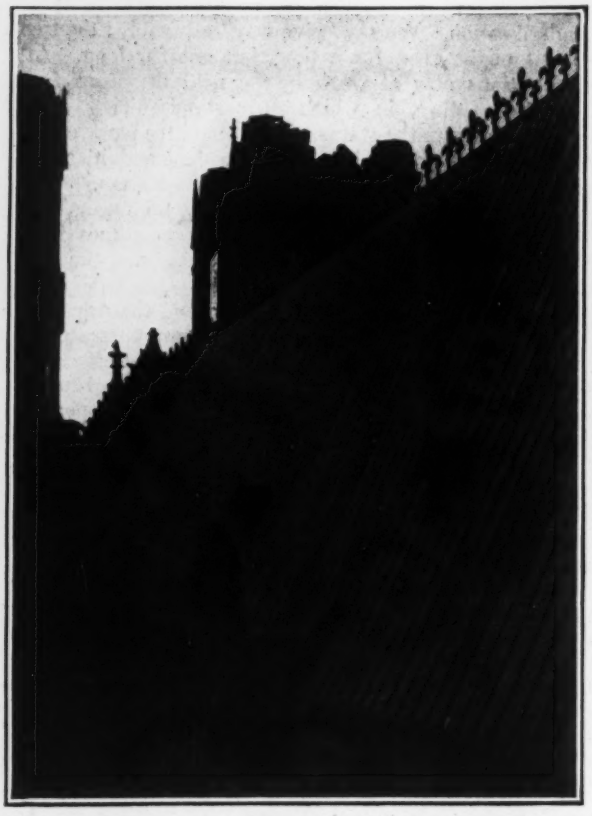


FIG. 1—THE COMPLETE SHEET LEAD ROOF OF THE CATHEDRAL
About 400 tons of lead were melted during the war; 250 tons were reclaimed, rerolled and replaced on the roof of the nave shown herewith.

FIG. 2—MODEL OF THE NAVE ROOF TRUSSES OF REINFORCED-CONCRETE ELEMENTS

The total length of the edifice is 490 ft., and its interior length 455 ft. The total width at the transept is a little over 200 ft. and the width of the nave, center to center of columns, is 48 ft. The height of the nave is 125 ft. and that of the façade of the towers 267 ft.

The apse framing consisted of seven trusses spaced about 12 ft. on centers. Each truss carried a principal tiebeam 50 ft. long, and 1 ft. square in section. Tie-rods and diagonal bracing assured rigidity. The smaller belfry placed at the extremity of the apse roof rested on the last truss, which was especially reinforced to carry the load. The roof structure of the nave presented two types of framing. For half of the length toward the transept the framing was similar to the foregoing, with the rafters (single pieces) in 57-ft. lengths and an 8-in. square section at the base. As it was difficult to find pieces of timber having such a section and such a great length, a system permitting the employment of timbers of less size was adopted for the other half of the nave.

The roof carried 400 tons of lead. The roof of lead was melted in the fire, but it was possible to salvage 250 tons which, when cast again into sheets, was utilized for the new roof.

Roof Structure Reconstruction—The reconstruction of the roof was undertaken from the point of view of making it as nearly as possible like the original structure. Timber was discarded as a reconstruction material be-

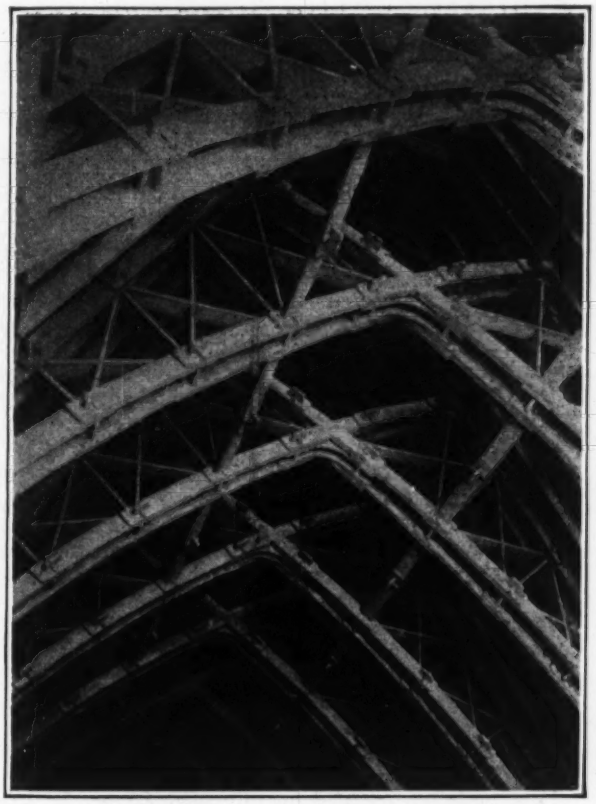


FIG. 3—CLOSEUP OF VERTEX OF MAIN RAFTERS

cause it was desirable to reduce to the lowest the danger of destruction by fire. Two other means were possible: use of either steel or of reinforced concrete. After some consideration of the use of steel it was discarded in favor of concrete, because in case of fire the steel would be subjected to possible deformation which might lead to the collapse of the roof structure. In addition, steel needs paint protection from rust. Use of reinforced concrete seemed the most advantageous from the point of fire resistance and freedom from deterioration.

Notwithstanding these favorable considerations toward reinforced concrete, difficulties in its use lay in the fact that it was necessary to simulate as nearly as possible the former wooden framing. Another disadvantage was the fact that all of the work was carried on between 130 and 200 ft. above the ground. These considerations led the designer, M. H. Deneux, to discard monolithic construction in favor of a carefully designed system of precast elements. By this design all formwork was eliminated, and the construction process was much the same as if the reconstruction of the roof structure had been in wood.

The system of reconstruction known as the Deneux system comprises the use of reinforced-concrete "planks" of a prevailing section 1½ x 8 in. and from 6½ to 10 ft. long, reinforced with ½-in. round rods. Some of these elements were cast for mortise-and-tenon joints, and some notched at the ends. The elements were therefore easily assembled by means of keys, and were as easily demounted. For this reason they were employed in temporary construction, because in the demounting they were not injured. Their assembly in place was also easy, inasmuch as the elements themselves were raised into place without any special equipment. A single pulley block fastened to the upper part of the scaffolding permitted the elevation of all of the parts constituting the roof structure. The wide applicability of these precast pieces for the work is indicated in Fig. 4.

When it was necessary to frame heavy members as, for instance, the main rafters, individual elements were put together two or three-ply, held together by keys and the joints cemented. Experience with this material showed that the strength thus secured was practically as great as that of a single framing element of equal sec-

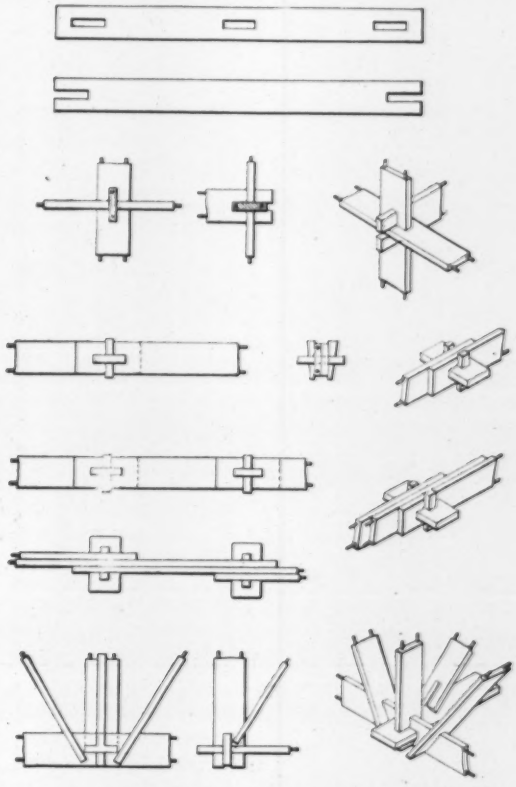


FIG. 4—STRUCTURAL ELEMENTS OF CATHEDRAL ROOF FRAMING

The "planking" is shown in longitudinal, oblique and orthogonal assembly. Both galvanized iron and oak were used in pins and dowels.

tion. Into the reinforced-concrete rafters are embedded wooden nailing strips for fastening the lead, slate or tile, depending on what roofing material was used.

The main nave roof trusses are, in effect, double trusses. The lower chord of the lower truss is an arch of 25-ft. radius supported on corbels in the side walls. The top chord rests on top of the walls. The lower chord of the upper truss is a flat arch and it also takes bearing on the corbels, and the top chord, again, bears on the top of the wall, the two bottom chords being tied. This framework was then independent of the main structure and was able to move freely.

Main rafters were constituted each of two thicknesses of reinforced-concrete planking, the joints of which were lapped. Between each two rafters spaced on about 6½-ft. centers, there were placed three rafters similar to the main rafters, but constituted each of only a single thickness of the reinforced-concrete elements. The arch spans were uniform in spite of a variation in distance between walls, which attained about 3 ft. in the length of the nave. These variations were compensated for by allowing the corbels to protrude as needed from the wall. The roof itself was formed of lead sheets about ⅛ in. in thickness, placed in strips. These lead sheets, whether of the old or the new metal, were rolled in the contractor's equipment yards, and were laid in single sheets, not laminated.

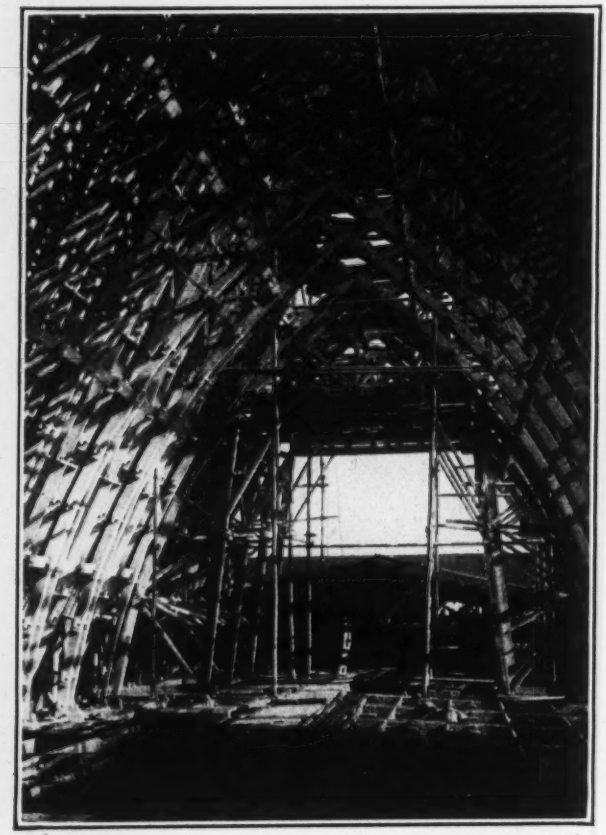


FIG. 5—NAVE TRUSSES FRAMED IN CONCRETE
Bottom truss carried on side walls, supports scaffolding for erecting the rafter-trusses.

The first application of this system of framing reinforced-concrete elements for such massive work was made by M. Deneux in 1920 and 1921 in the reconstruction of the roof of the Church of Saint Jacques at Reims, which also suffered from bombardment. M. Deneux has also been given the work of restoring Saint-Remi, the oldest church in Reims and almost as large as the cathedral.

Already 11,000,000 francs have been spent on the cathedral, of which 2,000,000 francs is a part of $1,000,000 given by John D. Rockefeller, Jr., for the reconstruction of the Versailles and Fontainbleau palaces and the Reims Cathedral.

The information contained herein was taken from a recent issue of *Le Genie Civil*. The photographs are used through the courtesy of that publication.

Designs for Joints in Large Pipe on the Ocean Bottom

Suggestions for Improvements That Have Arisen from Experience with Pacific Ocean Outfall Sewers Subject to Severe Wave Action

OUTFALL sewers laid on the ocean bottom on an exposed coast have been the subject of much study recently in southern California, both because of the many ocean outfalls to be built and because some of those already built have given considerable trouble, almost wholly at the joints. This article will be confined to the joint problem. It will include description of six joints, some of which have not been tried out but all of which are based on close contact with the practical problems involved. The wide variation in the designs presented indicates the lack of agreement on even the fundamental requirements of the joint design that will best meet the exacting conditions of wave surges and the attendant pressure variations. An element common to all the designs is the care taken in each case to bring all submarine operations within the scope of economical diver work.

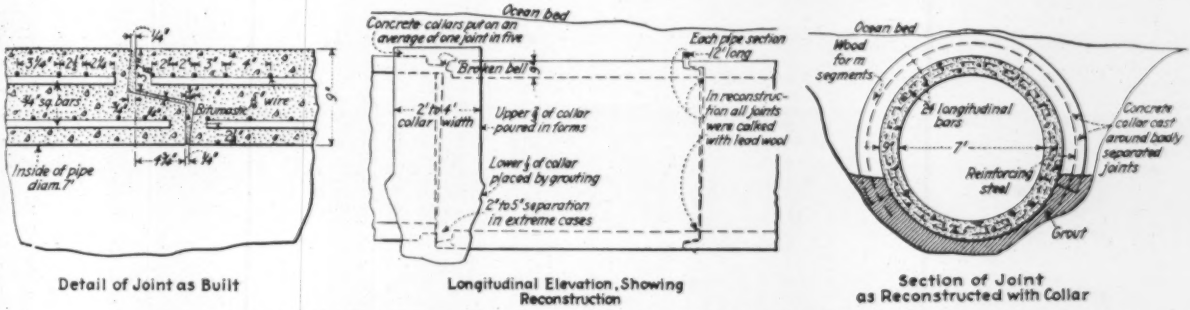
Design 1—The natural starting point in this review is the 7-ft. Hyperion outfall sewer built by the city of Los Angeles in 1923-24 at a cost of $687,434. This pipe, which extends 5,400 ft. out into the Pacific Ocean at right angles to an unprotected shore line, is subject to severe wave action. Almost immediately after the outfall was put in use it began to leak badly. The trouble was wholly at the joints and an extensive joint reconstruction plan was necessary. The cost of this reconstruction, amounting to $204,476, consisted chiefly in placing concrete collars around some of the joints and calking all of them with lead wool, all of which had to be done by divers. Softening of the mastic by the warm sewage is now rather generally accepted as the primary cause of the failure of these joints. (The temperature of sewage in this outfall is usually about 80 deg. F. The temperature of the ocean water on the bottom is 50 to 55 deg. F. in depths of 30 ft. or more and increases to about 70 deg. F. at the surface along shore.) There were other factors, and there is still question as to whether the result would have been serious if it had not been for the pressure variations and reversals caused by wave surges. This pressure pulsation was accentuated while the hydraulic gradient of the line cut between the crest and the trough of the waves. (For the history of the Hyperion outfall see *Engineering News-Record*, pipe manufacture, Aug. 21, 1924, p. 296; pipe laying, Aug. 20, 1925, p. 292; joint reconstruction, April 7, 1927, pp. 552 and 566.)

Design 2—In this type, flexible joints are provided at intervals, and the connections between adjoining sections are made very rigid by bolting up metal castings bedded in each end of each concrete section. Thus settlement or movement in the line that occurs after construction is forced to appear at the flexible joints. The joints are cast in the body of the pipe and consist of an annular gasket of lead pipe securely fastened to a perforated annular plate and arranged to permit the opposite sides of the joint to move or settle while the gasket deflects sufficiently to prevent leakage. The flexible joints would be spaced as may be dictated by the formation traversed and other conditions.

During construction, sections carrying the flexible

joints would be held rigid by stay bolts from one end of the pipe to the other to prevent premature functioning of the flexible joint. After placing the section in the outfall the stay bolts would be removed. Lead was chosen as the material from which to make the ring because of its resistance to the attack of the chemicals occurring in sea water. It is to be filled with packing or wicking to give it somewhat more resistance to complete collapse under pressure.

The spacing of bolts in the cast flanges would depend upon the strength of the flange itself and the distance of the flange from the flexible joint; ordinarily the spacing would be 18 to 24 in. Because of the difficulty that a diver would have in placing bolts on the lower 120 deg. of the circumference of such a pipe in place, a scheme was devised (see sketch) for placing these lower bolts from the inside of the pipe. The sections would be lowered into position with the long bolts in place ready for connection; one at the upper end of the vertical axis and one on each side at points 120 deg. down the sides. The initial bringing together of adjoining sections would be effected by drawing up these three bolts. Then the short flange bolts would be placed, inside on the lower 120 deg. and outside on the upper 240 deg. Whether the internal bolt recesses were grouted or not and whether the three long bolts were removed after the shorter ones were placed, would depend on conditions.


Ocean bed
Concrete collars put on an average of one joint in five
Each pipe section 12' long
Brown bell
2' to 4' collar width
Upper ⅔ of collar poured in forms
Lower ⅓ of collar placed by grouting
2" to 5" separation in extreme cases
In reconstruction all joints were calked with lead wool
Inside of pipe diam. 7'
Detail of Joint as Built
Longitudinal Elevation, Showing Reconstruction
Ocean bed
Wood form segments
24 longitudinal bars
Reinforcing steel
Concrete collar cast around badly separated joints
Grout
Section of Joint as Reconstructed with Collar

DESIGN 1—RECONSTRUCTED JOINT IN 7-FT. HYPERION CONCRETE PIPE OUTFALL

This design is submitted by the Los Angeles County Sanitation Districts, A. K. Warren, chief engineer; details having been worked out by A. M. Rawn.

Design 3—This is a flexible joint in that it permits movement of adjoining pipe sections about a horizontal axis fixed by the hinge bolts on the sides of the pipe. It contemplates, in effect, metal bearing surfaces for this movement, the metal castings being attached by hooked reinforcing bars to the concrete shell of each pipe section.

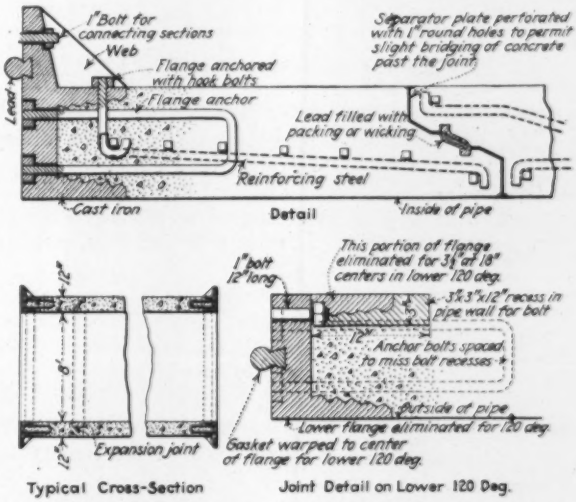
The pipe sections would be cast in vertical position. The cast-iron bell would be placed on a level platform around the inside form. The reinforcing would then be hooked into the web and small wedges driven under the hooks to put tension between casting and reinforcing while the concrete is hardening. When the outer forms were placed, the small iron pipe near the spigot end, which is later used for the eye-bolts, would be put in before concrete is poured.

The inside form would extend as much above the outside form as the length of the spigot and, when concrete had been poured to the top of the outside form, the spigot casting would be slipped on over the core form and set down about 1 in. into the outside form. The hooked reinforcing bars, 4 to 5 ft. long, would be inserted through hand holes, pushed down into the concrete and hooked into the web of the casting. The casting could then be filled with grout through the hand holes.

The diver would have only two bolts to place at each joint. The wood buffer in the joint proper would serve as a safeguard as well as a centering ring when bringing the sections together. One of the chief features of this design is the flat bottom of the pipe sections which gives a distributed bearing on the bottom of the trench. The effectiveness of this feature would be increased by making the trench excavation somewhat deeper than the finished grade and bringing the trench bottom up to grade with coarse gravel, leveled off by divers just before the pipe sections are placed. The outfall would be left for a period of days to allow it to adjust its weight on the gravel in the trench and grout would then be forced into the gravel, thus providing a uniform and substantial support for the outfall.

Final construction operation would be the lead-wool calking which makes the joint watertight. This calking would be done by divers on the inside of the pipe, working through manholes spaced about 150 ft. apart. A shoulder is provided in the iron castings as a convenient backing against which to do the calking, and the space thus provided is purposely made of a shape such that any movement of the pipe would further compress the calking material.

The ell-bolts holding the manhole plugs in place are

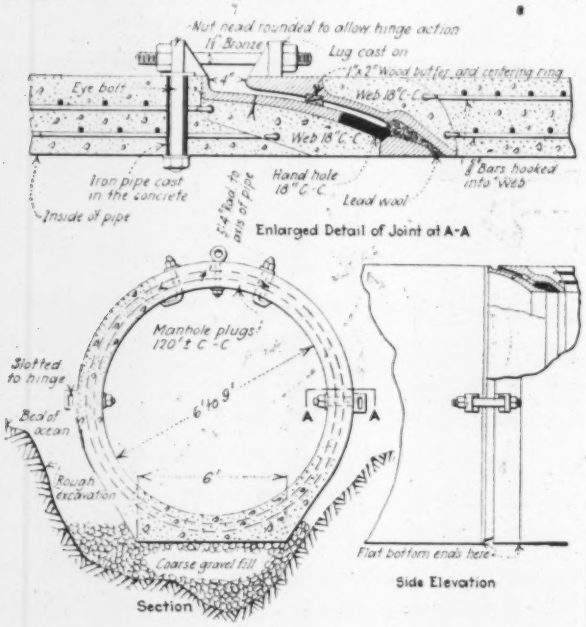

1" Bolt for connecting sections
Web
Flange anchored with hook bolts
Flange anchor
Separator plate perforated with 1" round holes to permit slight bridging of concrete past the joint
Lead filled with packing or wicking
Reinforcing steel
Cast iron
Detail
Inside of pipe
This portion of flange eliminated for 3½" at 18" centers in lower 120 deg.
1" bolt 12" long
3"x3"x12" recess in pipe wall for bolt
12"
Anchor bolts spaced to miss bolt recesses
Outside of pipe
Lower flange eliminated for 120 deg.
Gasket warped to center of flange for lower 120 deg.
Expansion joint
Typical Cross-Section
Joint Detail on Lower 120 Deg.

DESIGN 2—FLEXIBLE JOINT TO BE USED AT INTERVALS ON CONCRETE PIPE

Design submitted by Los Angeles County Sanitation Districts.

flattened on their outer ends beyond the nuts so that when the nuts are loosened the ell-bolts can be turned to swing into the clear on the inside of the pipe. These bolts as well as the eye-bolt for lifting out the manhole plug and the side hinge bolts are all made of bronze.

The manhole plugs are to be made when the pipe is cast. When a pipe section containing a manhole is tipped to a horizontal position after curing, a form is placed inside the pipe to cover the manhole opening and the plug is then poured in place to make a perfect fit. The plug, on removal, is marked for this particular manhole.



DESIGN 3—FLEXIBLE JOINT MOVABLE ABOUT HORIZONTAL AXIS OF HINGE BOLTS IN SIDES OF PIPE

Design by diving inspector connected with Los Angeles city engineer's office. Note the flat base of this pipe.

This design was suggested by C. L. Cooke, diving inspector, Los Angeles city engineer's office.

Design 4—This scheme, designed to utilize rigidity of the sort that obtains in a row of wide-flanged spools, thrust firmly together by pressure at the ends, contemplates the use of reinforced-concrete pipe in sections as long as can be handled conveniently. Before the sections are placed, a pair of reinforced-concrete sills would be set and properly spaced by divers in the trench at the point where the end of each section will land.

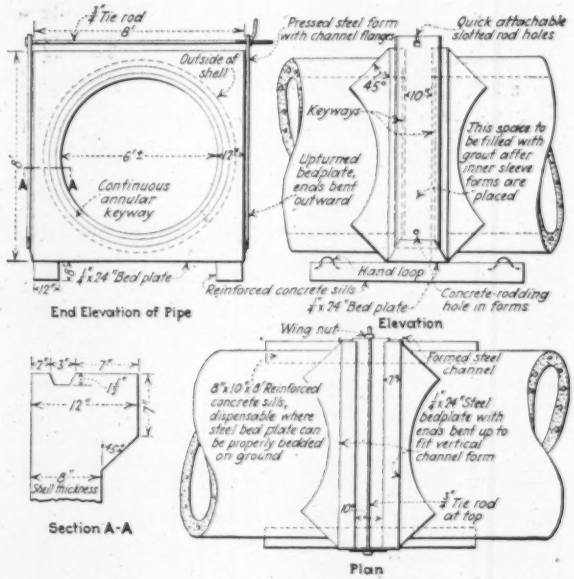
In landing the ends of the pipe sections on these sills, accurate placement is not necessary except that a diver must make sure that the separation of the two facing ends is not more than about 10 in. and that the steel plate, 24 in. wide, used as a self-centering bedplate and bottom form for the tremie concrete collar, is in place with both adjoining sections resting upon it. The upturned ends of this plate serve also as guides for the lower ends of the steel channels used as side forms. When these channels are thrust down over the upturned ends of the baseplate, the angle of inclination draws them close up to the vertical face of the square pipe end. These side forms are further held in position at the top by a horizontal tie-rod. This is bolted up by the diver and inside collapsible forms are placed before the tremie concrete collar is poured.

Bedding other than as shown is not required. A considerable length of line should be laid before concreting is started so as to allow as much time as possible for settlement to take place. The flexible side forms, however, should be placed immediately to exclude soil and to permit partial backfill prior to concreting.

Transverse annular steel reinforcement can be used in the plug, especially at the top, bottom and sides, to spread any shrinkage cracks that might occur when the concrete sets; and to provide transverse steel reinforcement similar to that used in the pipe shell.

This design was suggested by W. H. Pinkham, office engineer, north outfall sewer division, Los Angeles city engineer's office.

Design 5—This joint suggests what is thought to be an improvement on the one used in the 32-in. diameter outfall sewer recently constructed at Santa Barbara (see *Engineering News-Record*, Aug. 16, 1926, p. 292). The joints in this outfall are quite similar to those used at Hyperion. The concrete pipe sections were placed directly on the bottom of the trench and ocean action was depended upon for backfill. The backfill did not come in rapidly and the bitumastic filler, which was found to remain rather soft in the temperatures obtaining in the sewage, was forced out of some joints and leaks developed which had to be calked with lead wool by divers. Twelve joints were repaired in this way.


Tie rod
Pressed steel form with channel flange
Quick attachable slotted rod holes
Outside of shell
Keyways
This space to be filled with grout after inner sleeve forms are placed
Upturned bedplate, ends bent outward
Continuous annular keyway
Hand loop
Reinforced concrete sills
Concrete-rodding hole in forms
End Elevation of Pipe
Wing nut
Elevation
Formed steel channel
Reinforced concrete sills, dispensable where steel bed plate can be properly beaked on ground
Steel bedplate with ends bent up to fit vertical channel form
Tie rod at top
Shell thickness
Section A-A
Plan

DESIGN 4—WIDE-FLANGED JOINT ON CONCRETE PIPE OF LONG SECTION

Design by division engineer, Los Angeles sewer department.

As the result of observations on this outfall, it is suggested that the design could be improved by using a mastic and oakum filler on the bell end or inner cavity of each joint, increasing the size of the outer cavity and filling it with a 1:2 cement grout under pressure. The purpose of this grout filler would be to act as a wedge and to prevent the mastic from being blown out of the joint in case a leak developed past the oakum calking.

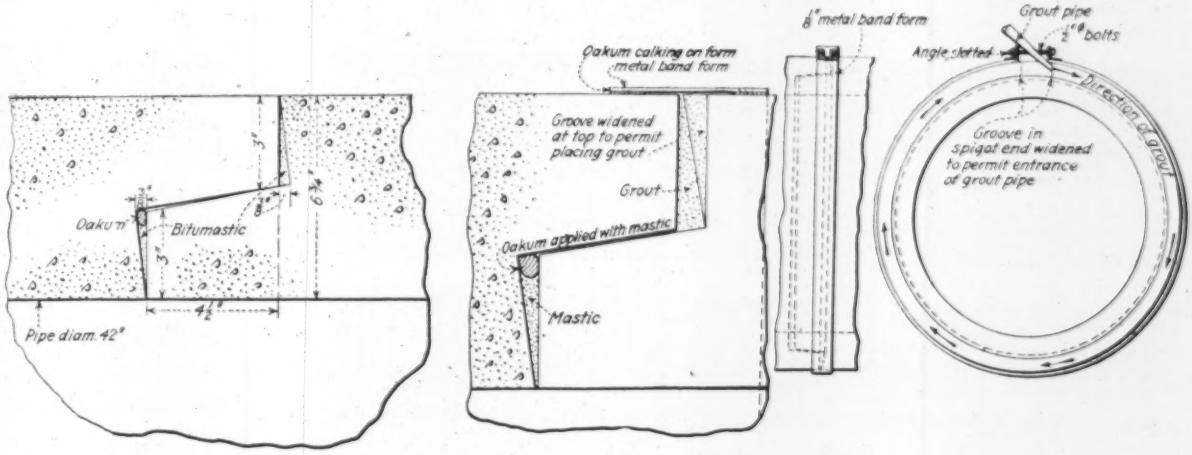
The grout would be put in through an opening at the top of the pipe made at the time the pipe was cast. The grout pipe would be inclined so that the grout would flow around the joint. The grout would be expected to encircle the joint completely and appear at the top on the side opposite to the grout pipe. A metal band around

the joint, made tight by oakum calking strips, would keep the grout from escaping except at the top. This band might be about 6 in. shorter than the outside perimeter of the pipe and would be drawn up into place by two bolts running through angles riveted to the ends of the bands which would be on top of the pipe; the seats for bolts on one angle could be slotted to allow easy placement and removal of the metal form. The oakum calking strips are riveted or wired to the plate.

This joint was suggested by L. R. Walker, assistant city engineer, Santa Barbara, Calif.

Design 6—The details of this scheme were developed for a 7-ft. diameter steel pipe to be made up on shore

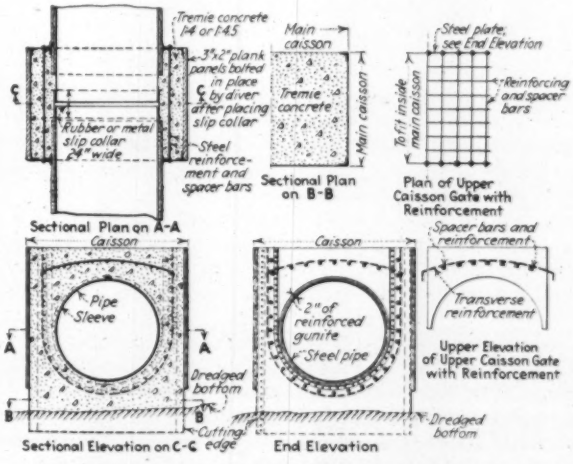
A steel caisson frame is put down on dredged bottom, ahead of the pipe sinking operations, at each point where a joint in the line is to be made. As the pipe sinks into place, adjoining ends of pipe sections are brought together within the caisson and a slip collar, mounted on one of the pipe ends before launching, is moved by a diver so as to cover the joint and is then bolted up. This slip collar is simply a top-bolted sleeve of heavy rubber belting and its function is to serve as an inside form for the concrete collar poured around the joint. With the sleeve in place, the diver places the upper caisson gate and bolts the plank sides on the caisson whose lower edge has meantime been pressed into the



Joint Used in Santa Barbara Outfall **Suggested Improvement on Joint Used at Santa Barbara**

DESIGN 5—CONCRETE PIPE JOINT WITH OAKUM FILLER, OUTER CAVITY GROUTED WITH CEMENT
Joint used at Santa Barbara, and proposed improvement.

in sections 200 to 500 or more feet long, bulkheaded, and floated to place for sinking. When a section is ready for sinking water is to be pumped in against the increasing air pressure until negative buoyancy is just reached and the section sinks slowly to the bottom. The


Tremie concrete 1:4 or 1:4:5
3"x2" plank panels bolted in place by diver after placing slip collar
Rubber or metal slip collar 24" wide
Steel reinforcement and spacer bars
Main caisson
Tremie concrete
Sectional Plan on B-B
Steel plate, see End Elevation
To fit inside main caisson
Reinforcing and spacer bars
Plan of Upper Caisson Gate with Reinforcement
Sectional Plan on A-A
Caisson
Pipe Sleeve
Dredged bottom
Cutting edge
Sectional Elevation on C-C
2" of reinforced gunite
Steel pipe
End Elevation
Spacer bars and reinforcement
Transverse reinforcement
Upper Elevation of Upper Caisson Gate with Reinforcement

DESIGN 6—JOINT FOR STEEL PIPE IN 200- to 500-FT. SECTIONS, LAID WITH AID OF CAISSON
Design from University of California.

final interior air pressure, if desired, may be made equivalent to the external water pressure and in case the pipe thickness is such that there is any question about the danger of collapse, internal pressure may be maintained until the pipe is partially backfilled.

bottom by the weight of the pipe. The caisson is then ready to be filled with tremie concrete. Each upper caisson gate is comprised of two end plates carrying a grillage of reinforcing bars as shown in the drawing.

This type of joint presupposes no great accuracy in the dredging of the trench or of the areas to be occupied by the joint caissons. In placing the slip collar, it is unnecessary to get the pipe ends closer than about 12 in. The final operation is to fill the caisson completely with tremie concrete.

This design was developed by Charles Gilman Hyde, professor of sanitary engineering, University of California.

Bituminous Sand Test Road, Canada

Three or four carloads of bituminous sand are now being shipped each week from the McMurray district of Alberta to Jasper Park for the road surfacing work being carried on under the supervision of Dr. S. C. Ells, of the Canadian Department of Mines. It is expected that altogether 90 carloads will be shipped to Jasper Park this summer for the most extensive practical test yet conducted with Alberta tar sands. Before the close of the season some three miles of graveled road in the Park will have a covering of the sand. The tar sand deposits of northern Alberta are rich in bitumen and they cover thousands of square miles, constituting the largest known bituminous sand deposit in the world. As far back as 1915 an experiment was made in surfacing a paved street with this material and it has been recently reported that this pavement, laid under the supervision of Dr. Ells, is still in good condition.

Concrete Cantilever Bridge With Flexible Expansion Bearings

Roadway Width and Waterway Clearance Lead to Adoption of Cantilever Type for Wyoming Bridge

By J. F. Seiler
Engineer of Bridges, Wyoming Highway Department, Cheyenne, Wyo.

A BRIDGE of unusual type has just been built by the Wyoming Highway Department over Crow Creek on the Lincoln Highway at the west city limits of Cheyenne, on the road to Laramie. It replaces an old bridge with dangerously narrow roadway (12 ft.) and structurally unsafe. Conditions were such as to lead to the adoption of a girder type of bridge with overhanging ends. To provide for expansion, one of the main piers was equipped with flexible-plate bearings.

Below the city water reservoirs, 25 miles upstream from Cheyenne, Crow Creek has a drainage area of 125 sq.mi., with fairly steep uniform slopes. The stream falls about 1,200 ft. in the 25 miles. Discharge calculations and comparison with other nearby bridges led to the conclusion that a waterway of 440 sq.ft. or a clear span of 85 ft. would be sufficient. Because of prospective parking of Crow Creek valley by the city, a single span was thought necessary. There was no question in the minds of the interested parties but that the structure should be of concrete. Subsoil conditions, however, indicated that arch construction was not feasible and a test pit confirmed this. Some form of girder construction was therefore necessary.

The future paved width of the approaches to the bridge is likely to be about 30 ft., and it was desired that the bridge should not form a serious constriction of the pavement. Hence a width of 27 ft. clear between curbs was adopted, with provision for future sidewalks on either side. With this width, through-girder construction was considered undesirable. On the other hand, the required span could not be obtained by deck-type construction, in view of the waterway requirements, unless the girders were made very shallow, which could only be done if the mid-span moments were compensated by end fixation or its equivalent. In order to satisfy this requirement a cantilever type of structure was adopted, using deck girders with long overhanging ends, these forming at the same time the abutments. The floor slabs in the main span act as compression flanges in the region of positive bending which occurs only under live-load.

There are four main girders. They overhang back of the piers a distance of 25 ft. on either end (see Fig. 1). In these abutments the two interior girders constitute counterforts and the outer girders the side walls. A bottom slab and cross-walls just behind the piers retain the earth fill; the bottom slab was constructed on forms, which were subsequently removed. Taking into account the buoyant effect of high water submerging the lower part of the abutments, and also the future sidewalk load, the design makes the mid-span bending stresses in the girders about zero under dead-load. It thus became possible to curve the girders to simulate arch construction, improving the appearance and increasing the waterway capacity.

As the superstructure with live-load represents a weight of about 1,500 tons, it was necessary to provide carefully for expansion and contraction. Sliding plates, rockers and roller nests were considered unsuitable. The great depth of the girders over the piers suggested the use of flexible vertical plates placed in the pier at right angles to the length of span, utilizing the well-known principle of elastic columns. This device, as worked out and constructed, is shown by drawing in Fig. 2 and by photograph in Fig. 3. The clear width between girders is 66 in., and each of the three bearings or plates is 62 in. wide and 9 ft. deep, embedded 18 in. deep in the pier and extending 6 in. up into the cross-beam of concrete between the main girders. The thickness of the main plate is $\frac{5}{8}$ in., but the plate is stiffened by vertical stiffner angles extending down to a point 9 in. above the bridge seat. The flexibility which allows for expansion of the bridge is provided mainly by this lower 9-in. section. In order to relieve the plate here of the bending moment due to the 500,000-lb. load on each plate when acting excentrically at maximum temperature displacement of $\frac{1}{2}$-in. (corresponding to 75 deg. either way from the mean of 40 deg. F., for which the plates were adjusted for plumb), two 9-in. I-beams are placed on the pier to provide a bearing for horizontal seat angles on the expansion plate. These I-beams protect the plate from vertical crippling, but do not interfere with its bending under temperature change.

FIG. 1—CONCRETE CANTILEVER BRIDGE OVER CROW CREEK AT CHEYENNE
Four main girders support a 27-ft. roadway on a main span of 85 ft. with abutment overhangs of 25 ft. each.

The resistance of the plate itself to bending is not much over 300 lb., for maximum displacement. It is possible for a large added resistance to be set up by earth packing around the end of the abutments. To minimize this, there was built under the rear end of the abutment at the expansion end a small buried pier or retaining wall capped with a cushion of treated timber and elastite, as shown by a detail in Fig. 2. Clearance between this pier and the girder ends was obtained by wedges placed under the timber cushion and withdrawn after removal of the abutment forms; the cushion was finally adjusted by drawing down the bolts which hold it to the concrete. Because of the retaining action of this pier only a small amount of earth can fall around the rear corners of the abutment.

Corrosion of the hinge plate is the chief deterioration to be feared. As the water level of the creek rises above the piers in high flood, the lower part of each hinge plate was heavily galvanized (electrolytically) before being assembled. The upper part was painted with two coats of red lead paint.

It will be noticed (see Fig. 3) that the main girders do not bear on the bridge seat at the expansion end, the entire load passing through the flexible plates. However, after the entire dead-load was in place and the earth fill in the abutments had been thoroughly compacted, the 3-in. space between girders and pier was packed with concrete placed on a ½-in. layer of elastite. This was done partly for appearance and partly to take up excessive vibration or impact effects.

In the cross-beam between the girders, through which the load of the structure is transmitted to the hinge plate, the question of shearing stress between the cross-beam and the main girders was important. A shearing stress of 120 lb. per sq.in. was allowed in the concrete, the cross-beam being relatively heavy for its length and the shear therefore in the nature of punching shear. Heavy reinforcement along the top of the cross-beam takes care of negative moment.

The entire superstructure was concreted in six operations: one each for the two abutments, including bottom slab, crosswalls and beams up to a point about 4 ft. above the bottom; and one each for the four main girders, including a section of roadway slab on each side, throughout the whole length of 135 ft. The last four operations required about 100 cu.yd. of concrete each. Construction joints were heavily coated with pitch, as were also the entire inside surface and back ends of the abutments. To waterproof the longitudinal construction joints in the floor, a wearing surface of 2 in. of asphalt was placed on the roadway.

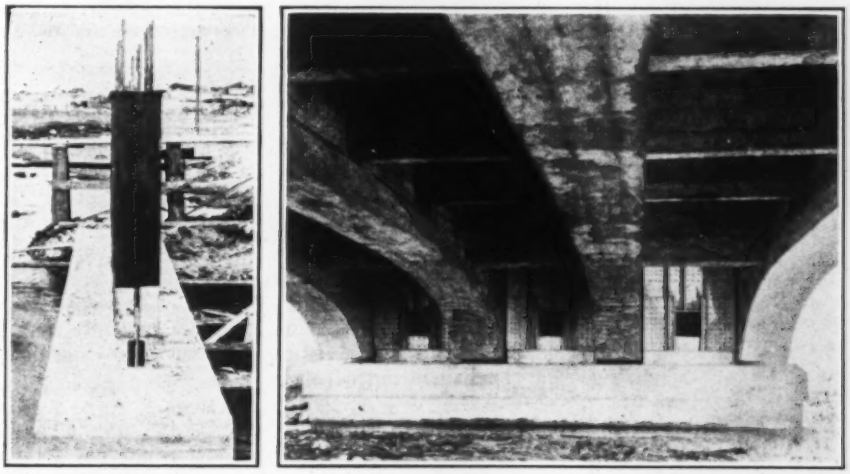


FIG. 3—EXPANSION PLATE IN PLACE ON PIER AND AFTER COMPLETION OF BRIDGE
Note that girders do not bear on pier. Expansion plates galvanized up to high water.

Predetermined-strength concrete was specified—2,500-lb. concrete for the substructure and 3,000-lb. concrete for the superstructure. Test cylinders, taken about one per 10 cu.yd., averaged 2,595 lb. for the substructure concrete and 3,237 lb. for the superstructure concrete, the latter (32 cylinders) ranging from 2,852 to 3,560 lb. The concrete was mixed to a slump of 2 to 4 in. Some occasional excess water appeared in the pier forms, and

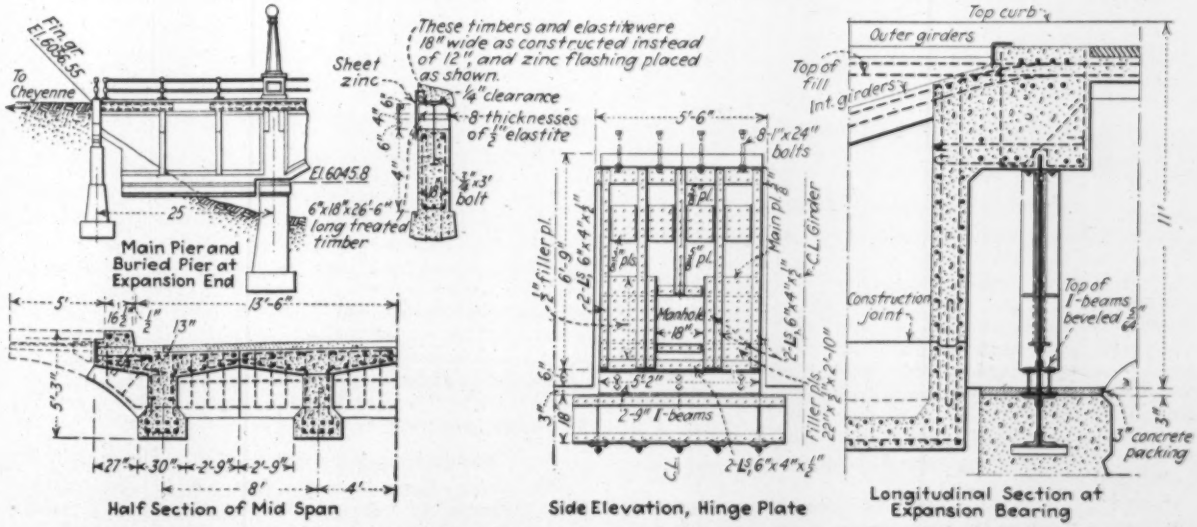


FIG. 2—CROSS-SECTION, EXPANSION BEARING AND BURIED END PIER

was taken up by dry batches, but in the superstructure forms no excess water was apparent at any time, though the forms were of excellent construction and type. Three pounds of Celite per sack of cement was used as an admixture, which appeared to reduce the time needed to mix the concrete and improved its workability. The concrete was chuted from a tower, but little or no segregation was noticed, and after removal of forms the surface was for the most part smooth and dense in spite of some difficulty in spading the concrete around the bars where they were displaced by inaccuracies in bending. Apparently a high degree of workability was secured for the slump used.

When completed, the bridge proved to be very rigid, possibly in large part due to the great weight of earth filling in the overhangs. The passage of heavily loaded trucks at high speed produces no perceptible vibration, such as is observed in many other structures of concrete.

The following members of the highway department were concerned in the design and construction of the bridge: Z. E. Sevison, state highway engineer; the writer, as designer; W. A. Norris, engineer of materials, who designed the concrete mix; and J. E. Lloyd, resident engineer in charge of construction. F. J. Anderson, of Casper, was the contractor. The cost of the structure was $30,000, including grading and surfacing of about 2,000 ft. of approaches.

Makeup of Breached Levees Given in Report by Colonel Potter

Mississippi River Commission President Lists Materials and Methods of Construction of Levees Which Failed

DETAILS of the way in which the Mississippi River levees which failed during the recent flood were built, the character of the material of which they were built and their general conditions are given in a report made to the Chief of Engineers by Col. Charles L. Potter, president of the Mississippi River Commission, an abstract of which is given below.

When the crevasses occurred, the question was raised as to whether the levees which gave way had been built in any particular way which might have resulted in their being weaker than other portions of the system, whether they had been built by contract, or by the government with day labor or with government machines. Colonel Potter covers these points in his report. The government machines referred to, unless otherwise stated, are slackline tower excavators.

Dorena Crevasse—Main River

Description—Low levee without banquette but was under enlargement by cutting off levee top to make banquette and building levee in front (usual method). Enlargement seriously hindered by very unusual weather and river conditions throughout fall which finally stopped work on Dec. 20, although hope of continuing work was not finally abandoned until Feb. 2. Top had been cut ahead of machine. As flood was approaching it was temporarily raised by teams to better than original height and section. As flood became more menacing it was built up with sand bags 1 to 2 ft. above water level when topping blew out under the sacking.

Material—Sandy.

How built—By contract in 1912. Was being enlarged by government machine but enlargement had not reached point of break.

Whitehall Crevasse—Main River

Description—Levee line was threatened by caving bank and loop was being built behind. In order to get his machine to loop, the contractor cut gap in main levee but built it back to better than original section. Break occurred at that point when flood level was 5 ft. below levee crown. Was entirely unexpected and so unusual as to support theory that bank under levee may have caved. This will be determined later.

Material—Sandy.

How built—Built by contract and enlarged several times by contract. Final enlargement in 1925 by government machine (boom) from land side pits. Not enough material between levee and revetment to supply enlargement material.

Knowlton Crevasse—Main River

Description—Levee was near caving bank and setting it back was provided for last year but local interests could not put up their third of cost; money therefore could not be expended under flood control act; and had to be transferred to other work. Had levee been set back last year, would have been higher and well back from caving bank. Owing to being near mouth of White River there was water on both sides of levee and all flood fight material had to be barged in. With this handicap, and rapid rise in river, workers could not keep ahead of flood and levee was overtopped.

Material—Loam.

How built—By contract. Had never been worked on by government machine.

Laconia Crevasse—Main River

Description—Money allotted last year to set levee back from caving bank, had to be withdrawn because local interests could not put up their quota, as required by law. Levee failed in low stage of flood by being caved into the river.

Material—Original levee buckshot. Enlargement, 1908, loam.

How built—By contract. Was never worked on by government machine.

Pendleton Crevasse—Arkansas River

Description—Low levee, to be enlarged under this year's program. Levee top was 2 ft. below grade established by the commission; river stage was more than 4 ft. above record; and therefore more than 3 ft. above levee crown. Was built up with sand bags above flood level but severe storm washed off sacks faster than they could be replaced in howling gale and severe rain. River and storm beat the workers.

Material—Sandy loam.

How built—By levee board with teams. Government had never done any work on it.

Medford Crevasse—Arkansas River

Description—Levee built to commission grade and section but had settled in some spots, not yet brought up. River was 5 ft. above previous record or 2 ft. above levee crown. Levee was being topped by negro labor when Pendleton crevasse occurred and labor deserted.

Material—Sandy loam.

How built—By contract in 1920. Had never been worked on by government machine.

South Bend Crevasse—Arkansas River

Description—Levee, considerably below commission grade, was being topped up against the unprecedented river stage. Trouble, however, developed around a short and low spur left where a loop line had joined the main line. Unusually strong current eddied around the angle and attacked the levee. Was held for several days but finally went out.

Material—Sandy loam.

How built—By levee board contract. Government had never done any work on it.

Mound Landing Crevasse—Main River

Description—Levee was practically to full grade and section. Arkansas City gage was 2.5 ft. above previous record and water in the bend on other side was running over the levee in many places. It was only a question as to *where* the

break would occur. At the exact point of break a ferry boat had been making frequent high water landings against the levee and possibly had disturbed the material. Due to height of water (practically at the crown) the line of saturation passed above the banquette crest and water began coming through with increasing force till the levee blew out above the banquette line.

Material—Light sandy loam.

How built—Originally built in 1887 by contract; enlarged by contract in 1901; enlarged by contract in 1909; and finally enlarged by U. S. levee machine (cableway) in 1922. A government inspector, appearing as a witness against the government in the investigation of 1922, is spreading the report that this break occurred at a point where he saw the machine doing bad work prior to that investigation. The work was done several months after that investigation.

Cabin Teele Crevasse—Main River

Description—The levee was very low and was under contract for enlargement, the contractor having been drowned out by unusual high water in October, 1926. The break occurred at a very low point ahead of the enlargement. The end of the east side levee is only 3 miles below this point, and it felt almost the full effect of the water coming out of the Yazoo basin from the crevasse at Mound Landing. Sacking had been carried up 5 ft. above the levee crown. With the necessarily narrow base of the sacking, with 4.5 ft. of water against it, and with a severe wind and rain, it could not stand the strain and toppled over.

Material—Buckshot—the best of material.

How built—Original levee built with teams by the United States in 1909-10. Enlarged in 1919 by contract made by levee board. Government machines have never worked on the levee.

Winterquarters Crevasse—Main River

Description—Levee had been raised to full grade and section but at point of break levee crown had tendency to slide and had been rebuilt three times since 1925. Crown sloughed again during high water fight and water went through.

Material—Buckshot.

How built—Originally built in 1900 by teams under contract and enlarged in 1923 by machine under contract. Government machine has never worked on this levee.

Glasscock Crevasse—Main River

Description—Levee was 3.5 ft. below commission grade. Had been topped against the rising water and kept ahead of the rise, but with narrow base and saturation from long exposure the topping slid off.

Material—Sandy clay.

How built—Originally built by contract with teams in 1899; enlarged by contract with teams and wheelbarrows in 1900; and again by contract with teams in 1908 and 1922. Government machine had never worked on this levee.

Brabston Crevasse—Main River

Description—Levee was 3 ft. below commission grade and was topped ahead of the flood. Due to extreme height and long duration of exposure to saturation, levee crown became soft and sloughed off carrying topping with it.

Material—Buckshot.

How built—By contract with wheelbarrows. Never had been enlarged. Government machine had never worked on this levee.

Bougere No. 1 Crevasse—Main River

Description—Levee was 3.5 ft. below commission grade. Thin crown had been topped ahead of the flood. Owing to extreme height and long duration of exposure to saturation, levee crown became soft and slid out carrying topping with it.

Material—Buckshot.

How built—By teams under contract in 1905 to 1910. Had never been enlarged, but was under contract for enlargement. No government machine had ever worked on this levee.

Bougere No. 2 Crevasse—Main River

Description—Levee 4 ft. below commission grade. Treatment and break same as Bougere No. 1.

Material—Buckshot.

How built—By teams under contract in 1905 to 1910. Had never been enlarged but was under contract for enlargement. No government machine had ever worked on this levee.

McCrea Crevasse—Atchafalaya River

Description—The Mississippi River Commission had never fully extended its jurisdiction to this levee. The levee was built by local authorities and enlarged by them. Prior to the Melville crevasse the current in the Atchafalaya was very swift and heavy scour had set in at McCrea. When the Melville crevasse occurred the river fell six feet in one day at Melville, largely accelerating the already swift current. This produced excessive caving at McCrea and the levee was undermined.

Material—Sandy loam.

How built—Entirely by local interests under contract—originally built by teams and enlarged by machine. No government machine had ever worked on this levee.

Melville Crevasse—Atchafalaya River

Description—Mississippi River Commission had never assumed jurisdiction, and levee was built and enlarged by local interests. Exact cause of break has never been known—probably levee too weak to stand the strain.

Material—Sandy clay.

How built—Originally built by contract with scrapers and enlarged by contract with machine, and by convicts with wheelbarrows. No government machine had ever worked on this levee.

Junior Crevasse—Main River

Description—The levee was in good condition, it had been protected against wave-wash by recently constructed wooden revetment, and was in no danger from the flood. On April 23, 1927, the levee was rammed by the steam tank ship *Inspector*, causing the crevasse.

Material—Buckshot.

How built—Built in 1910 by government (boom type) machine and hired labor.

Summation

Of the 17 crevasses, two, and possibly three, were caused by the banks' caving them into the river; at least two were caused by heavy storms which swept off the sacking; two were probably due to weakened condition of levees by traffic through or over them; but most of them were caused by the fact that the section was never intended to hold such stages. The levee crown is supposed to be well above the line of saturation, with a flood 3 ft. below the levee grade. With the water at or above levee grade, the crown is subject to complete saturation and, under these conditions, makes a poor foundation for added topping.

At the point of rupture of the 17 crevasses only one levee (Junior) was originally built by government machine, and that was by boom machine against which no complaint has ever been made, many similar machines being owned and operated by contractors. In this case the crevasse was accidentally caused by the ramming of the levee by a ship. Of the remaining 16 crevasses, one (Whitehall) had been built by contract and had been several times enlarged by contract but had been finally enlarged by a government boom machine. Of the remaining 15 crevasses, only one (Mounds) was in a levee that had ever been worked on by government machine. This was a final enlargement of a levee which had been built, and twice enlarged, by contract. The work was done by cableway machine, the class of machine against the work of which W. L. Thompson, chief engineer of the Board of Mississippi Levee Commissioners, made complaint, causing the commission's investigation of 1922.

The enlargement at the point of break was done several months after the investigation and after the commission had specifically provided for giving all government machine work exactly the same careful inspection that was given to contract work. The levee at this point was probably weakened by being used as a high water landing for a ferry.

It therefore is a matter of fact that the levee at only one of the 17 crevasses occurring this year had ever been worked on by the class of machine the work of which had been condemned, and it is almost equally a fact that the break at that point had no relation to the method of doing the work. At 14 of the crevasses no work ever had been done by any class of government machine.

Sixth Article of a Series on
HIGHWAY MAINTENANCE

Snow Removal Methods and Equipment

By V. R. Burton
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WE HAVE seen from the preceding study of the climatic factors affecting snow removal that by far the largest amount of snowfall comes from storms of small intensity. If this snowfall were undisturbed by the wind, snow removal would be a simple and inexpensive procedure as only light equipment would be necessary in removing snow and the cost would be only a fraction of the actual figures. The most expensive part of snow removal is the removal of drifts deposited in the roadway. These drifts are caused by snow being blown along the surface of the ground until some point is reached at which the velocity of the wind is slowed down beyond its power to carry the snow particles farther, when they drop and form the drift.

Theory and Prevention of Drifts—Observations at our experimental station at Alba last winter showed that practically the entire amount of snow deposited was carried along the surface within 6 in. of it. Any obstruction to the air current sweeping along the surface causes a decrease in velocity both before and behind the obstruction and causes the deposit of snow being carried along the surface. The amount deposited of course depends upon the amount being carried by the air stream and upon the amount by which the velocity is decreased.

The objectionable feature about drifts is that obstructions cause them to be deposited within the roadway. In order to eliminate difficulty from drifts two alternatives are open to the highway engineer: either crown the roadway, or, if this is impossible, use artificial or natural barriers to cause the drift to form far enough away from the road so that the body of the drift does not reach it.

In cases where it is at all possible the snow should be encouraged to sweep directly over the roadway. The design and construction of the highway should take into account the effect of drifting snow on winter maintenance; shallow cuts should be avoided; the surface of the ground should be followed as closely as possible, preferably with the grade line at least 18 in. above the surface. In heavy snow territory, cuts should be widened to supply ample storage space for the snow which may drift into them or which must be removed from the roadway. Turnpikes should never be built with widths of less than 30 ft. from shoulder to shoulder, if sufficient storage space for truck removal is to be had. Side hill locations are bound to cause trouble. Rights-of-way should be wide enough to permit the use of snow fence on their boundaries. It is certainly poor policy to build into a road features which later make snow removal difficult and expensive.

As a matter of maintenance all brush and woods should be cut which are near enough to cause drifts to form within the roadway; the lower branches of trees should be trimmed wherever it is possible; if the rights-of-way are narrow, hedges and old picket or wooden fence should be replaced by wire fence; and old wooden guard rails on fills should be replaced with cable guard rail, but if this is not possible all but the top should be removed and stored until spring.

In addition, methods of removal should take into account that a snow barrier erected along the sides of the roadway is just as effective in stopping snow within the roadway as the artificial barriers erected to prevent this very thing. It is a fundamental part of Michigan's policy to carry on snow removal work in such a way that high banks along the roadway are avoided wherever possible. Pictures of banks of snow higher than the top of an automobile are no longer shown as an example of efficient snow removal. Views of the enormously high banks published in former reports of this department are at the present time looked on only as an evidence of inefficient drift prevention or snow removal or both. In some cases it is of course impossible to prevent these drifts from forming, especially where turnpikes are so narrow as to prevent our standard method of removal being followed, but they are no cause for boasting.

Drift prevention when well done permits the use of lighter equipment in the heavier snowfall districts where a few years ago it was declared useless. Only too often heavy equipment is necessary to open a short stretch of road in districts of comparatively light snowfall, where a little attention to drift prevention would have obviated the necessity for anything but a light plow.

The use of artificial barriers, or snow fence, to form drifts off the roadway is becoming a subject for a good deal of attention to all engineers engaged in the work of snow removal. The use of natural barriers where the existence of wide rights-of-way makes their use possible is one of the best means of controlling the situation. Where snow conditions are particularly severe in Michigan it is found that in most instances a width of right-of-way of from 150 to 200 ft. will prevent drifts from reaching the road where a thick natural growth of underbrush and bushes is encouraged near the edge of the right-of-way. Evergreen hedges are very effective as snow fence.

Another method of forming snow barriers was developed to a large extent last winter by A. L. Burridge, division engineer of the Michigan State Highway Department at Cadillac. This method consists in plowing snow traps in the fields adjacent to the roadway by means of truck or tractor snow plows and causing the drifts to form from the snow ridges left by these plows. From two to four of these snow traps are plowed in the field along the roadway and their use has proven very effective in a number of cases, at a cost considerably less than that of snow fence. This method is of course not possible where the terrain is too rough for field plowing and will not by any means eliminate the necessity for using large amounts of snow fence. Wherever conditions are favorable for its use, however, in cultivated fields or cleared up cut-over territory, it is confidently

believed that large savings will be effected by this method. This field plowing is illustrated in Fig. 1, taken by a representative of the Bureau of Public Roads in Michigan last winter.

Experimental work by the Michigan State Highway Department has shown that the standard 4-ft. picket fence with 1½-in. pickets spaced 1½ in. apart is the most practical snow fence yet devised. A closer spacing of picket stops snow in a somewhat larger amount, but not in a degree great enough to justify the expense of the additional number of pickets necessary for closer spacing. Wider spacing of pickets increases the velocity of the wind through the opening so that the length of the drift formed is objectionable. In the same way, due to a greater depth of air stream intercepted, with a resulting increase of velocity between the pickets, fences higher than 4 ft. are not so practical. The 6-ft. picket fence does not increase velocity to an objectionable degree, but its cost is about double that of the 4-ft. fence and since its capacity is not correspondingly increased its use is not economical. Greater heights than 6 ft. are positively objectionable due to the greater length of drift formed. The method, therefore, which the Michigan State Highway Department intends to standardize is the use of 4-ft. fence placed upon fence posts which are either high enough to permit the raising of the fence during the winter or are of such a type that they can be spliced and the fence raised to the additional height.

The distance that this fence should be placed from the road depends on the amount of snow to be expected to accumulate throughout the entire season, the height of the fence, the character of the fence and the direction of the prevailing winds. The slope of the ground also has an influence because if the slope is down hill toward the road the length of the drift will be increased. If the fence is too close to the road the drifts will form in the roadway; if it is too far away, winds cutting diagonally across the distance between the fence and the highway will pick up the snow again and deposit it in the highway. If the distance is entirely too far, even winds at right angles to the fence will pick up the snow between the fence and the road and drop it in the road. The proper distance from the roadway for fences of varying heights was the subject for study in Michigan last winter but the analysis of data is not yet completed for publication.

It is safe to say that the careful study given drift prevention in Michigan is the direct cause for the successful adoption of the doctrine of continuous removal in our heaviest snow districts with a resultant drop in cost of winter maintenance of about 50 per cent.

Snow Removal Equipment—No general rule can be laid down for the use of equipment but consideration of the class of service to be given, the amount of snow to be moved, and the amount of snow which will accumulate during the removal season should govern choice. Outside of the straight-blade plow in regions of light snowfall and high temperature, snow removal cannot be satisfactorily done with a single type of plow. The standard method used in Michigan at present is to use a light plow patrolling the center to maintain travel and a heavier plow to increase the width of cleared road.

The fundamental condition for continuous highway service lies in not permitting more snow to accumulate than an automobile can go through. The ordinary automobile has a road clearance of about 10 in., and for distance not over 10 to 20 ft. in length the car can push through 12 in. of snow, but in deeper snow or in longer drifts progress is impossible. If, then we are to provide uninterrupted highway service, drifts of more than 12-in. depths cannot be permitted to accumulate.

FIG. 1—EXAMPLE OF SNOW TRAPS PLOWED IN FIELDS ADJACENT TO ROAD

In order to maintain the road with no greater than 12-in. depth a considerable width of cut will be necessary. The usual width of turnpike in Michigan varies from 24 to 36 ft. and the snow cut is maintained over the entire width of the turnpike. A 30-ft. width provides enough storage space for drifting snow so that it takes a very severe storm completely to block the cut to traffic. It also provides space for storage of snow removed from the center until this can be moved out of the cut width to be maintained.

From the standpoint of the maintenance of the road surface and shoulders, the wide cut is also necessary. When the snow is permitted to pile up on the edge of the surface, the insulating effect of the snow prevents the frost from going as deep under the edge as it does in the center. As this frost thaws out in the spring the center is heaved considerably higher than the sides, resulting in considerable damage of the surface. Places have been destroyed where this differential heaving amounts to as much as 6 in.

The melting ice and snow running down the shoulder along the metal produce bad washouts and soften the shoulders. If the snow is moved entirely off the turnpike the runoff is more nearly confined to the ditches and a large amount of this damage is eliminated.

Where continuous service is to be given, our problem is to maintain a road on which the snow gets no deeper than about 12 in. over a width wide enough for cars to pass. This class of maintenance can be secured only by fast-moving vehicles operated on the patrol system, keeping the center open. The use of these plows must be supplemented by a liberal supply of snow fence and heavier equipment to throw back the snow ridge which the lighter plows leave in regions of heavy snowfall.

There will of course be all gradations of service as long as highway departments are limited in their equipment budgets, with an ever expanding snow removal program. In some sections it may not be considered that the traffic warrants continuous removal, but that is a fallacy because the intermittent service given with heavier plows is practically as costly as the continuous method, if snowfall is at all heavy. The only reasonable excuse for other than continuous service lies in the financial inability of the maintenance forces to supply sufficient plow service.

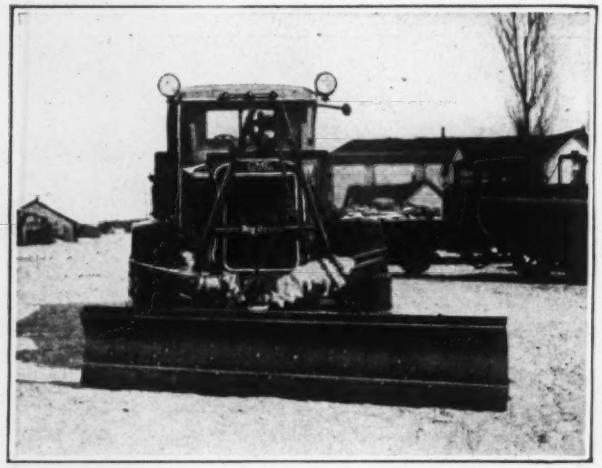


FIG. 2—TRUCK BLADE PLOW FOR 12 TO 20 IN. OF SNOW

It should be understood that this discussion covers only those ranges of total annual snowfall up to about 150 in. and mean winter temperature of over 16 degrees. Where conditions are more severe the number of patrol plows necessary for continuous service might be impracticable, although even then proper drift prevention and wide roadway widths would make it possible to keep the road open most of the time.

Storms of extreme violence will block a road occasionally even in regions of only moderately heavy snowfall. Like any other maintenance problem, the methods adopted in snow removal should meet the conditions which obtain usually, with a liberal allowance for overload and not be designed for the extreme cases. If we wished to provide for service which would be practically uninterrupted four years out of five in Michigan, we would need to count on the maximum storm of only 10 in. With adequate drift prevention this amount of snowfall could be easily handled by the customary methods.

So far as use by a modern state highway department or county is concerned, a number of plows actually in use by smaller units of government are practically obsolete. A number of others are special purpose plows which are not suited for general use on main highways. Those plows which are considered to be the most suited to present-day highway practice are all pushed plows, both light-duty or patrol type, and the heavy-duty type. The following is a list of those plows with the recommended power units which are considered best suited for this work:

(1) Displacement plow: Light duty—high speed:
  (a) Blade, 3 to 3½-ton truck.
  (b) "V," 3½-ton truck, 6 cylinder motor, pneumatic tires.
(2) Rotary plows: heavy duty; twin rotors; 10-ton tractor.
(3) Combination pusher rotary; heavy duty, lateral type; 10-ton tractor.

Plows using the 6-ton truck have not been included because for maintenance work, in this state at least, there is little use for so heavy a truck. For economical maintenance it is of course necessary to use a propelling vehicle which can be used for summer maintenance as well as winter.

The truck blade plow on a 3 to 3½-ton truck illustrated in Fig. 2 will move from 12 to 20 in. of snow, depending on the density of the snow to be removed. Where snowfall is heavy and winter temperatures low the ordinary 18 to 22-in. height of the commercial blade is not enough and a 12-in. extension is necessary to provide sufficient height of plow. This plow will handle all the snow which it is possible for traffic to move through and therefore no heavier type is necessary for patrol work alone, if it is intended to keep the road open to traffic at all times and the snow accumulation on the sides is not too great.

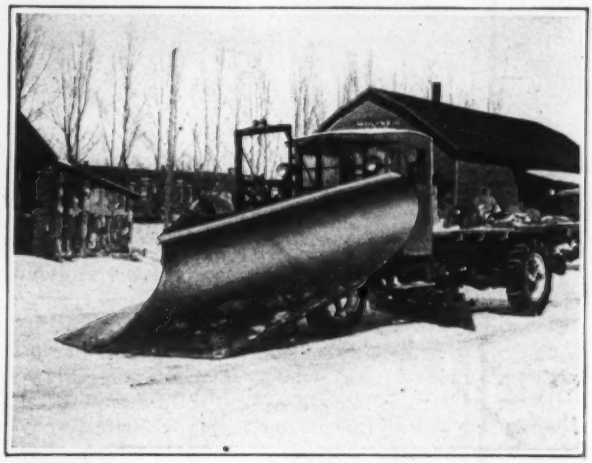


FIG. 3—V-BLADE PLOW FOR DEEP SNOW

Where wide roadways are maintained, and especially where traffic is heavy, the center 8 to 10 ft. is kept fairly clear during a storm if patrol is kept up along both edges. Passing vehicles stir up the snow as it blows on to the pavement and it is carried across by the wind and deposited on the lee side of the cut. Nearly all vehicles attempt to stay in the center fairly consistently due to the tendency to keep out of the snow collecting along the edges. The plows can then omit the 6 or 8 ft. in the center on their rounds and take advantage of this work of traffic. This condition can be taken advantage of fully only by the one-way plow.

The fact that the snow is moved in one direction only by the blade plow gives it an immense advantage over the "V"-type of truck plow whenever it can be used. The full width of the blade is available on every trip while with the V-type only half the width of the plow is available after the first trip over the road. Thus, if we wish to clear 16 ft. of roadway by patrol for continuous service, a round trip of a blade giving 8 ft. cleared width will give us the desired width, while a V-plow clearing the same 8-ft. width must make at least three trips over the road to secure it. The "V" plow will handle about a foot more snow than the blade but this is no advantage where service is continuous for center clearing.

Unfortunately in some of our heavier snow districts where the total annual snowfall exceeds 60 in. and where winter temperatures are low, the side accumulations in the latter part of the winter make the use of the straight blade plow impossible at times. Dependence for patrol work must then be placed on the V-plow, mounted on a 3½-ton truck, a popular type of which is shown in Fig. 3. This plow should be so shaped that it will lift the snow and roll it up and back instead of pushing it to one side. If this plow is properly shaped speeds of from 20 to 25 miles per hour will throw the snow from 30 to 40 ft. from the plow. The greater speed obtainable by the use of this type of plow compensates to some extent for its lack of width after the first trip, and with a wide cut to start with there are few storms which can snow in a plow of this type continuously employed on a beat of twenty miles or less.

The V-plow is used for widening as well as for center patrol and where wide cuts are maintained can handle all that is necessary for some time. In the early part of the winter, for the first two months, it is frequently found that this type is all that is necessary for this purpose, as it will easily handle 3 ft. of newly fallen snow. The V-plow does not leave a smooth road surface especially where enough snow is left to maintain sleigh traffic. This difficulty is overcome by swinging an ordinary gravel floating blade beneath the truck as shown in Fig. 3. This blade will keep the winter surface in perfect shape and can be used when the plow is on fairly heavy work.

As the winter advances in heavy snow districts or if unusually severe storms occur quite close together the widening operation must be done by some heavier type of equipment. The heavy-duty V-plow, with elevating wings attached, has been and is still being used for this purpose. This plow is pushed with a 10-ton tractor and will handle up to about 4 ft. of snow if both sides of the plow are used. This means 4 ft. of snow moved and does not mean the 7- or 8-ft. banks of the displaced snow left by the plow.

Due to the high banks left by this type of plow its use is decidedly objectionable. These banks increase the amount of snow to be moved as well as the difficulty of removing it. No more plows of this type will be purchased by the Michigan State Highway Department and those plows which we have are being redistributed to regions of only moderately heavy snowfall.

The heavy duty rotary, axial type, is probably the best plow for extremely deep snow if the snow is dry. Wet snow causes considerable trouble from the clogging of the rotors. The separate motor on this plow permits the fullest use of the tractor in shoving it into the bank with rotors going at full capacity. Unfortunately the only commercial type used in Michigan cannot change the direction of throw and so must throw snow into the wind part of the time. This causes some rehandling of snow and makes it extremely difficult to see enough to drive the plow properly. The very high cost of this plow and its expensive operation makes its usefulness extremely limited. It is doubtful if it is an economical plow for less than 130 in. of snow annually in a cold territory. Proper drift prevention would permit the use of lighter equipment at lower cost.

The pusher rotary is a combination push plow and rotary, with the rotors on an axis at right angles to the road, relieving the pressure on the faces of the V push plow and throwing the snow to one side. It works very well in snow up to 4 ft. deep and actually can handle snow up to about 6 or 8 ft. As soon as the snow is over the rotors, however, progress is extremely slow, although, it will go through places where the tractor V would simply have to be dug out by hand. In snow less than 2 ft. deep the plow can be used full width on all trips, as only a slight ridge is left.

In order to increase the capacity of this plow and permit faster operation where side banks are high, a

FIG. 4—ROTARY PLOW WITH SIDE CUTTER BLADE TO BREAK DOWN SIDE BANKS

cutter blade attached to the rear end of the tractor was developed in the Cadillac division last winter. A rotary at work with this blade is shown in Fig. 4. The blade is pulling the snow into the road behind the plow where it can be picked up by the rotors and thrown over the bank on the next trip. The rotors are clearing the snow pulled down by the blade on a preceding trip. The cutter blade shown in the illustration is vertical but later models are tilted at an angle of about 30 deg. from the vertical in order to permit a freer use of the rotors. This method exemplifies the effort made to get the snow as evenly spread as possible away from the road and not merely to push it out to one side.

This plow is the most practical one we have for widening where snow conditions are severe and side ridges objectionable. In the deeper snow from 3 ft. up there is a slight ridge left, but the side cut is vertical and the ridge not nearly so high as that of the displacement plow. The heavier chunks are deposited nearest the rotors and the ridge on the outside gradually slopes off the original drift surface. The Michigan State Highway Department is practically standardizing on this plow for widening use.

Tractor-operated plows should be used at as high speed as possible in widening. It is much more economical to take a small cut of only 2 or 3 ft. if the snow is hard packed than to attempt to buck a cut of 5 or 6 ft. in low gear with frequent stops and backing up for another start. Tractor plows should also be suspended from the tractor when not in operation. Any plow mounted on sleighs is decidedly objectionable if it cannot be raised and carried on the tractor when bare road metal must be traveled. These sleigh plows cannot be used late in the spring without considerable danger of having them stranded miles from headquarters.

Power for all plows should be chosen with an idea to year round use. Ten-ton tractors are used for grading and planing gravel in the northern part of the state. There are only a few more required for snow removal than can be used the year round. This unit then is the proper one for tractor-drawn plows.

Trucks for heavy snow removal which have proven most satisfactory are the 6-cylinder 3½-ton trucks of

FIG. 5—ROAD WIDE ENOUGH FOR CONTINOUS PATROL REMOVAL

about 70 horsepower. These trucks are capable of a sustained speed of 30 miles per hour. They should be equipped with pneumatic tires if sufficient traction is to be had for snow removal. These trucks are used in summer maintenance almost exclusively for floating gravel roads, except for a few trucks used for material haulage. Heavier trucks than these are of little use in gravel road maintenance and have not the speed of the lighter trucks. Speed is essential with the V-plow if it is to be operated so as to throw the snow instead of piling it up.

Where the total annual snowfall is under about 40 in. nothing but the blade plow will be necessary. From 40 to 60 in. each truck should be equipped to use either a blade plow or a V-plow. From 60 in. up the trucks should have both V- and blade plows and the later widening will have to be done with a pusher rotary. With snowfall of less than 120 in. the pusher rotary can handle the widening and with extra care in drift prevention probably considerably more than this.

Plow beats should be carefully chosen so that the full run may be made in one direction. Half of a cleared road for the length of section keeps traffic moving when the time consumed making a return trip on a half-section might leave the other half section long enough to block it. Using a system of plow beats radiating full length from a central headquarters insures the system being opened at the earliest possible time if a blockade should occur.

The present system of center clearing by continuous patrol and later widening permits the use of the heavy equipment in good weather much of the time when the snow cloud stirred up by the rotors will not be blown back by the wind. It gives service incomparably better

FIG. 6—NARROW ROAD PREVENTING CONTINUOUS PATROL REMOVAL

and just as cheap or cheaper than the old method of clearing after a storm with heavy equipment. It has been proven successful up to snowfalls of well over 100 in. annually and it is the belief of the Michigan State Highway Department that it can be used in every section of the state with only minor tie-ups.

Two views, Figs. 5 and 6, are shown to illustrate the difference in the two systems of removal. These pictures are both from Antrim County within three miles of each other. The first shows a road with a width of turnpike sufficient to use the continuous system. The second shows the situation on an unimproved road with narrow turnpike where a wide roadway cannot be maintained and consequently continuous patrol is impossible. There is no snow fence used in either case due to lack of funds to buy enough, and field plowing of snow traps was not carried out here. There can be little question but that service is more satisfactory in the first illustration and cost records prove that the second is more expensive.

Winter maintenance includes other things than the actual work of removal and drift prevention. In the fall narrow turnpikes must have the shoulders and culvert locations marked by stakes and posts, culvert and tile outlets must be cleaned. Farmers must be warned to move their mail boxes back. After the removal work starts the surface must be maintained as smooth as for summer traffic. Curves and hills must be sanded when the surface becomes icy. After frost heaves start, if they become severe, their location must be marked by caution signs to insure the safety of traffic.

Snow removal costs are becoming fairly definite wher-

ever the standard methods of removal are used. In Michigan these costs varied from $6.27 per mile for 27 in. of snow to $366 for 112 in. during the winter of 1926-27. The average for over 100 in. was about $200. It is confidently believed that the maximum cost can be cut by proper drift prevention and the adaption of the standard method of removal, to $200 per mile.

The technique of modern drift prevention and snow removal by continuous patrol in heavy snow territory has been largely developed in Gogebic County and in the Cadillac division. The methods developed in these places will next year be adopted as standard over the entire state. It is felt that the experimental period has been passed and that a uniformity of practice may be followed which will insure a uniformity of results and give costs which are really comparable.

[*The last article on road maintenance will be "Federal Influence and Authority," by Thomas H. MacDonald, chief, U. S. Bureau of Public Roads, Washington, D. C.* —EDITOR.]

The Cost Reduction Drive in German Industry

Rationalization Is Being Effected by Consolidation and Standardization—Government Aids Through Publicity Work

By E. J. MEHREN
Vice-President, McGraw-Hill Publishing Company, Inc.

COST reduction is the great slogan today in German industry. Necessity forces Germany to produce as cheaply as possible, for export trade is vital to her economic rehabilitation, and export trade the world over is hampered by high tariff walls and beset with strong competition. The cost-reduction idea has taken hold not only in industry, but in the ranks of labor and of the general public. "Rationalization" it is called. The subject is up at every meeting of industrial associations; labor is studying its mechanisms and effects; the general public accepts it. One is reminded of the furor over "scientific management" in the United States twenty years ago, when the work of Taylor, Emerson and Gantt first came to large public notice, except that here the interest is even keener.

Of course "rationalization" is much broader than "scientific management." Consequently, there is a wider group of industrialists and engineers available for attacking the problems. Further, with characteristic German thoroughness, the approach is fundamental. No avenue is left unexplored. Research, study, compilation, agreement by industrial associations—all these go on with an intensity, surprising, inspiring, and very significant for Germany's future and the place of the country in foreign trade.

What is "Rationalization"—What is meant by "rationalization," the visitor inquires. The word, old in philosophical discussions, is newly applied in Germany to denote the many methods by which production costs can be lowered. It includes standardization, simplification of varieties, waste reduction, scientific management, and the replacement of hand labor by machinery, as well as the consolidation of corporations with a view to securing plant specialization, the closing of uneconomic production units, reduction of overhead, economy in selling.

Industrial Consolidation—Consolidations have gone on apace in recent years. The Vereinigte Stahlwerke, A.G., a large consolidation of steel mills, with a capital of 800,000,000 marks; Demag, A.G., a combination of companies manufacturing cranes and steel-mill machinery, and, largest of all, the Interessengemeinschaft Farbenindustrie, A.G., commonly called here the I.G., a great combination of chemical plants with a capital of 1,100,000,000 marks, are illustrations of the tendency. These and many others are children of the past two years. As a result there have been plant specialization, full operation of efficient units and the scrapping or closing down of inefficient ones, strengthening of research and technical personnel, combined selling, etc., etc.—all of the fruits that flow from capital grouping. Many of the companies are too new to show full results in profit-and-loss statements now, but of the ultimate result there can be no doubt.

Here, as in the scientific and engineering work, there has been government encouragement. Taxes on consolidation transactions effected within a given period (which closes this September) have been reduced. For example, there is a 7 per cent tax, payable by the purchaser, on all real-estate transfers. To encourage industrial consolidations this tax was temporarily reduced to 1½ per cent. Again, there is a stock issue tax of 4 per cent on the value of the property covered by the stock issued by a new corporation. This tax has been temporarily reduced to 1 per cent, but only for such new companies as represent consolidation of existing corporations.

Out of this consolidation era are doubtless coming great corporations, like those mentioned, that will play a large part in the German industrialism and foreign trade of the near future. Germany, it is commonly said here, has too many small corporations. The present difficult conditions are forcing a lot of them together.

Government Encouragement—As to the engineering and scientific contributions to "rationalization," a noteworthy feature is the government encouragement that is offered. We, too, have government encouragement of waste reduction work, as exemplified by the activities of the Department of Commerce under Secretary Hoover. But here the encouragement, in addition to being suggestive, takes the form of financial assistance.

For the direction of this enterprise, the government has established the Reichskuratorium für Wirtschaftlichkeit, a name which may be translated as National Trusteeship for Economic Studies. Of this organization Dr. Carl F. Von Siemens, head of the well-known Siemens-Schuckert Works, is chairman, and Dr. Hans Hinnenthal general director. The purpose of the Kuratorium was first to bring together a lot of cost-reduction movements that had got under way, both during and after the war, and then to serve as a clearing house, to learn what was going on, to discover gaps and then, with government funds, initiate and temporarily support such studies as were needed, but would otherwise not be made. The Kuratorium as such makes no studies. It is an administrative body and uses agencies already set up, or helps in the formation of new ones. These agencies in all cases are built up by the industries themselves, though temporarily they may get government support. In 1926 the Kuratorium advanced funds to 24 different research organizations, giving the money in every case for specific investigations and not for general support.

Investigations Supported — The investigations supported cover a broad field, including scientific management, standardization of purchase specifications, bettering of methods in office practice, simplification of varieties, coal economies in dwelling-house heating, use of waste materials, application of machinery to the farm, materials-testing methods, research in use of non-ferrous metals, building-construction methods, improvement in and simplification of dwelling-house design, preparation of study material for apprentices in industry and for students in the higher industrial schools, problems of the works engineer, possible economies in handwork trades, economy in household work, researches in welding, and heat economies in glass-melting furnaces. The total of funds advanced is not large, only 1,470,000 marks in 1926, but that is due, first, to the youth of the organization (it began active work in 1925), and, second, to its policy of using funds for encouragement only and to have the large amounts come from industry.

An additional noteworthy feature of the Kuratorium's work is its plan for propaganda to secure widespread use of the standards and practices agreed upon. News items, bulletins, pamphlets, handbooks of practice, exhibits of standards and good practice that can be sent to expositions, industrial conventions, chambers of commerce meetings, schools, etc., films and statistical publications are included.

Standardization—Probably the most important institution engaged in this rationalization enterprise is the Deutscher Normenausschuss, or German Standardization Committee, conducted under the direction of Dr. Hellmich. It is a child of the great German engineering society, the Verein Deutscher Ingenieure, and dates back to war times, to 1917. Its first name was Standardization Committee of German Industry, but its work has broadened so much that the reference to industry was dropped last year. The Ausschuss itself is a co-ordinating body largely, yet so extensive is its work that there are fifty people in its office in Berlin. The detailed technical work is done by committees in the various industries and these have no less than twenty established offices for handling their work. It is estimated that the total expenditure for this standardization work, including travel and office administration, runs to 300,000,000 marks annually.

The procedure is much like that of our American Engineering Standards Committee. The technical work is done by appropriate committees of engineering or industrial associations, and on completion is submitted to the Normenausschuss. If there is no conflict with other standards the proposed standard is printed in the technical press, with notice that eight weeks are available for submission of criticisms. These criticisms are taken in hand by the committee, and a second draft submitted and published. Again there is opportunity for criticism. After further reworking, the standard goes to the board of directors of the Normenausschuss for approval as a DIN (Deutsche Industrie Normen) standard.

To Jan. 1, 1927, approval had been given to 1,950 standards, embracing those of general application, such as for paper, screws, rivets, pipe threads, pipe, etc., and standards covering specific fields. Some of the fields are welding, building materials and building parts (such as door and window sash), mining equipment, railroad cars and locomotives, electrical equipment, steam boilers, foundry equipment, wood-working machinery, refrigerating machines, automobiles, farm machinery, machine tools, ship building, typewriters, textiles and textile machinery.

Looking After Small Savings—Attention is frequently given to subjects that seem of minor import to Americans. Take, for example, standardization of correspondence paper. True, we have "standardized" or "recognized" a limited number of sizes of mill sheets, and have recommended sizes for magazines and catalogs, but the German goes further, right down to business and private correspondence paper. Not only does he set the size but he adopts a standard for the arrangement of the letterhead—such space for the firm name and address, such space for the addressee's name and address, such space for the addressee's receiving stamp and notations. Finally, having made the standard he carries on vigorous propaganda for its adoption. This propaganda is clever and far-reaching. In railroad stations you see striking posters showing a sheet of writing paper and an envelope with the injunction "Use only DIN paper sizes for your business and private correspondence," and below the legend, "The new Reichs (or National) sizes." Here again is government help, as the railroads, and therefore the railroad stations, are owned by the government. Further, on the letterheads of corporations one will find the legend "DIN format," the equivalent of "DIN paper sizes," and the government helps further by using the legend "Write on DIN sizes" on its postal cancellation stamps. Finally, pasters, to go on letters, are furnished to all who will use them, requesting those addressed to adopt DIN sizes.

Extent of Acceptance—The extent of the use of these standards is difficult to measure. No figures are available, but the office in Berlin is satisfied with the progress. Personal inquiry in different parts of the Reich have convinced me that the use is widespread, that the standardization work is well-known, highly regarded and supported not only by the engineers but by the executives of industry as well. Further, a good beginning has been made in international standardization on the Continent, and there are half a dozen groups of general standards that have the approval of from six to a dozen national standardizing bodies.

Conclusion—To give a satisfactory picture of this German effort in industrial rationalization would require treating in detail the work of some of the committees allied with the Reichskuratorium. But space forbids. Let it suffice to say that the work is equally virile in the other fields, even if not so far advanced as that of the Normenausschuss; knowledge of the work is widespread, there is general support and approval, and will to apply as rapidly as possible. It is the view of industrial leaders that all this work heading up in the Reichskuratorium as a clearing house is doing much for the economic rehabilitation of Germany.

For Germany the work is obviously important. For us in America it should be a spur and challenge to still further effort along the lines of scientific cost reduction, in which we have already made good progress. Germany knows, acknowledges and compliments us on what we have done, and is profiting by our experience. We must not rest content. Friendly competition in rationalization will be helpful to both nations and their citizens.—

DÜSSELDORF, JUNE 17, 1927.

Open Dredging Sinks Deep Piers for African Railway Bridge

DEEP pier foundations sunk mainly by dredging in open concrete caissons through sand and clay to rock, but requiring the pneumatic system for one of the piers, have been put down for the Umgeni River bridge on the North Coast Line of the South African Government Rys., running north from Durban, Natal. This bridge, for a double-track line of 3 ft. 6 in. gage, has nine through truss spans of 109½ ft. c. to c. of piers

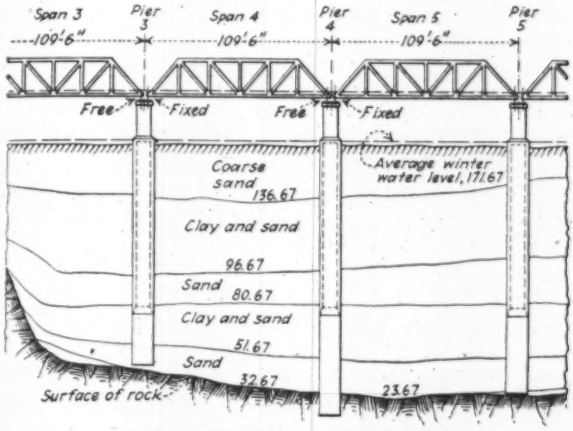


FIG. 1—UMGENI RIVER BRIDGE

and two through plate-girder spans of 60 ft., the latter on curve at the south end of the bridge.

Each pier consists of two concrete columns 9 ft. in diameter, connected above the water line by a concrete diaphragm reinforced with old rails. The foundations are pairs of concrete cylinders 12 ft. in external diameter and 2 ft. thick, having steel cutting edges built up of plates and angles. These cylinders were sunk to rock, or to boulders overlying the rock, at depths of 60 to 156 ft. below low-water level, and were filled with 1:4:8 concrete.

With steel cutting edges placed in position on a bed

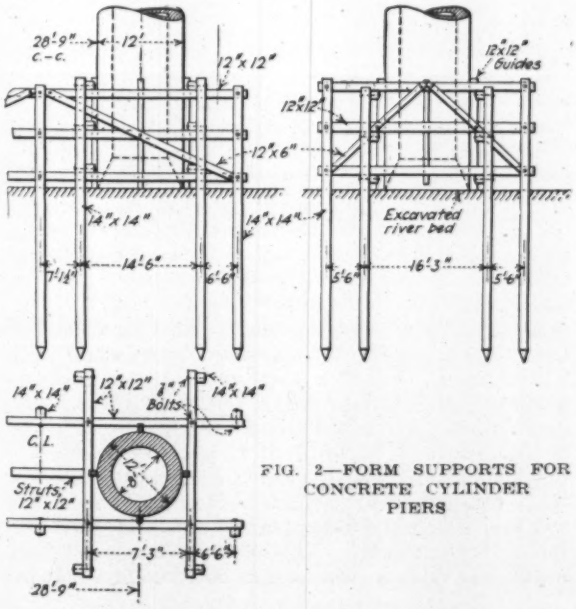


FIG. 2—FORM SUPPORTS FOR CONCRETE CYLINDER PIERS

of broken stone which had been deposited in advance, the two cylinders of each pier were built up 20 ft. of 1:3:5 concrete, steel forms being used. Sinking was commenced, after 7 days, by excavation inside with grab

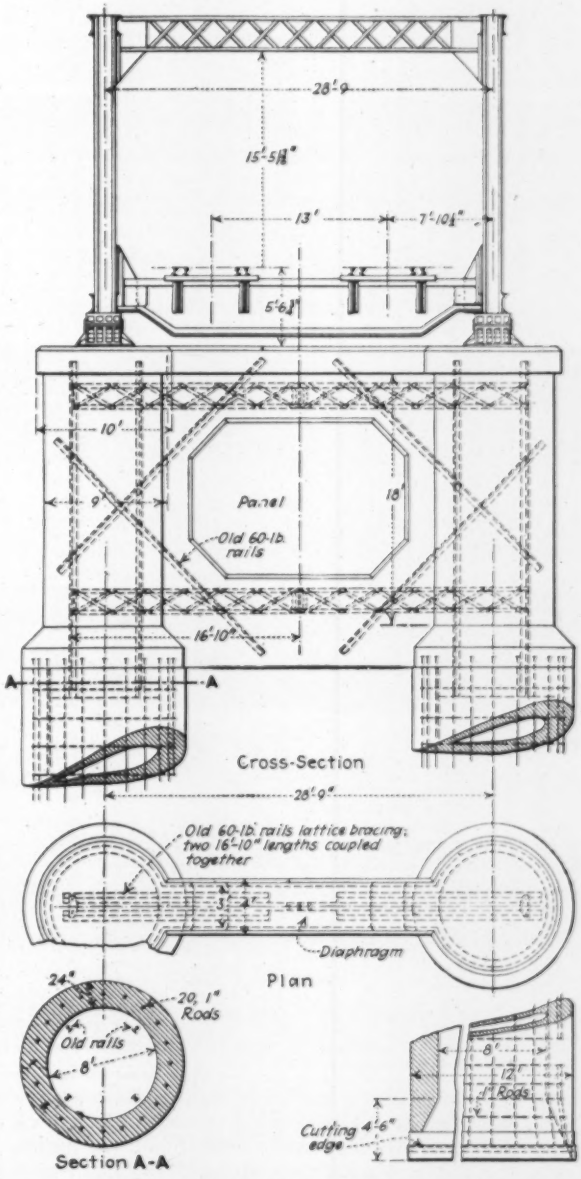


FIG. 3—TYPICAL PIER OF UMGENI RIVER BRIDGE

buckets, and continued in successive 20-ft. build-ups until the desired foundation was reached.

The cylinders were sunk in pairs and no staging or falsework to insure their vertical position was necessary. They sank easily by their own weight, no loading being required until the cutting edges reached boulders. Concrete filling was placed under water by means of skips. Compressed air was used only at pier 2. Two 5-ton steam traveling cranes operated the grab buckets and concreting skips.

Foundation and superstructure were completed in 27 months, considerably interrupted by floods.

The design and construction of the bridge were under the direction of R. C. Wallace, chief civil engineer, South African Railways and Harbors.

Rapid-Transit Railway at Sydney, Australia

Elevated and Underground Lines with City Loop—Concrete Retaining Walls and Arches Have Stone Facing—Twin Tunnels—Stations and Flyover Crossings

THE rapid-transit electric railway system of Sydney, New South Wales, the first part of which was opened in December, 1926, will include underground lines in the business district and surface lines connecting with the suburban railways and extending across the great cantilever bridge now being built over the harbor to connect with lines in North Sydney. The elevated part of the line, passing the Central Terminal Station is shown in Fig. 2. This project was described in *Engineering News-Record* of July 8, 1920, p. 56.

From the four-track main-line railway entering Sydney from the south, suburban traffic will be diverted at Redfern by the eight-track city railway, paralleling the former as far as the Central Terminal Station, as shown by Fig. 1. Beyond the Central local station, six tracks go underground to the Wynyard station, whence four high-level tracks will extend across the new bridge while the two low-level tracks loop around the business district and return to the Central local station. Proposed extensions include: (1) an inner loop, *A*, serving an eastern suburban line; (2) a second connection, *B-B*, between Wynyard and Redfern for bridge trains, and (3) western and southern suburban extensions *C* and *D*. In North Sydney the line will connect with an existing railway now isolated, while additional lines in that section are planned.

From Redfern, the round-trip route by the city loop is 5.5 miles, with 18 miles of track. From the Central station the round trip of 3.6 miles is to be made in 11½ minutes. On the portion now in operation, Central to St. James, the run is made in 2½ minutes, which is said to be about the time otherwise required to leave the train at the Central Terminal and board a downtown street car. The longest distance between stations will be less than a mile.

Flyover Crossings—A feature is that at track intersections the grades are separated by "flyover" crossings. A special layout of this kind is required in the south approach to the Central local station, since the arrangement of eight tracks for northbound and southbound trains alternately is here changed to alternate pairs, so that each of the four island platforms is served by trains in one direction only. As these tracks are assigned to specific routes, the connections and grades are complicated; in fact, this is said to be the largest crossing of the kind in the world, having fourteen flyovers supplemented by two crossings at grade but used only by trains in the same direction.

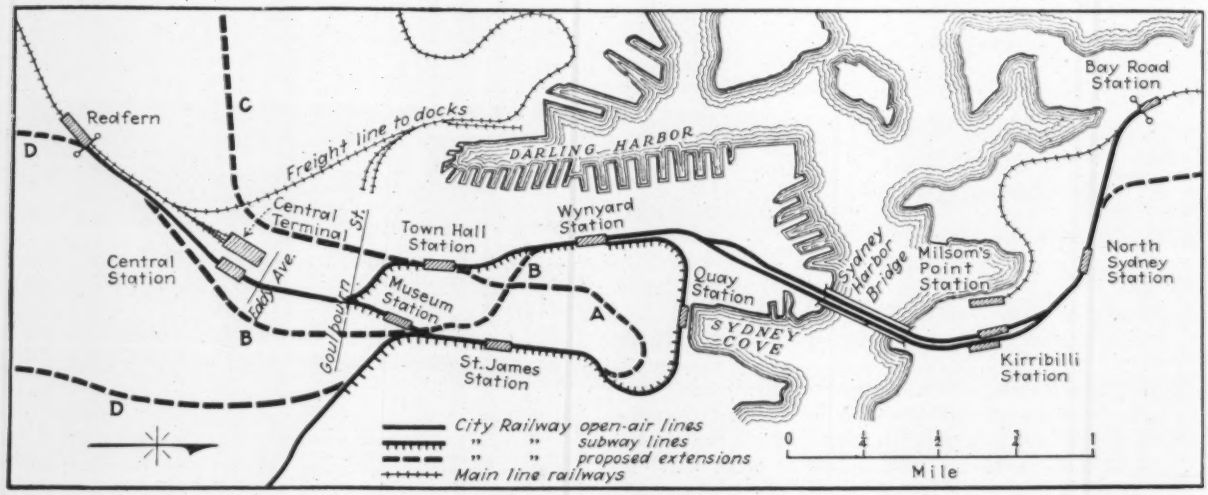


FIG. 1—RAPID-TRANSIT RAILWAY; SYDNEY, AUSTRALIA
A cantilever bridge of 1,650-ft. span will carry the line across the harbor, *A*, *B*, *C* and *D* indicate proposed extensions.

Part of this crossing is shown in Fig. 3, with high level tracks on each side of the roadbed for a depressed track. The spans are mainly 24 ft., with 24-in. I-beams spaced 36 in. and cased in concrete jack arches having a minimum thickness of 16 in. These spans are supported by brick piers, 3½ ft. wide, with concrete footings and having a maximum height of 20 ft. The use of brick masonry for viaduct piers and tunnel walls is an interesting feature of this work. Skew spans have plate girders carrying stringers cased in concrete. Solid fills between retaining walls form the approaches.

Elevated Structure—For the elevated portion of the line, Fig. 2, a solid fill is retained by concrete retaining walls and streets are crossed by arch spans, all concrete being faced with sandstone. This stone is rough-faced for the walls and smooth dressed for the arches. The walls are about 35 ft. high to top of parapet. Foundation work for these walls is of an unusual character, consisting of concrete piers sunk 27 ft. to rock and having longitudinal segmental arches of 18-ft. span sprung between them. At one point longer spans are required to cross a volcanic dike 20 ft. wide, where bor-

ings could find no bottom to the decomposed basalt. Piers 7 ft. long and 16 ft. wide were built in open shafts 18x7 ft., between which trenches were dug for the foundation arches.

A typical street bridge at Hay St. has an elliptic barrel arch of 81-ft. 8-in. clear span, 17-ft. rise and 20-ft. 9-in. headroom, with a width of 78 ft. 9 in. between parapets. After the stone facing had been erected on the centering, the concrete arch was poured in five sections, 15½ ft. wide between construction joints. A waterproof course of two ¼-in. coats of mastic is covered with brick in cement and then hand-packed rubble to subgrade. At the north end of the Central station, the line crosses Eddy Ave. at an elevation of 21 ft. with a five-span ribbed-arch concrete bridge 94 ft. wide between parapets; the three elliptical roadway arches are 36 ft. 2 in. wide and the sidewalk spans 12 ft. 3 in. This bridge is constructed as a series of continuous girder ribs carrying a reinforced-concrete deck. The ribs, 7 ft. 8 in. apart, are 25 in. wide and 3 ft. to 9 ft. 8 in. deep.

FIG. 4—CENTRAL STATION; SYDNEY CITY RAILWAY
Eight tracks and four island platforms. Brick walls for platforms.

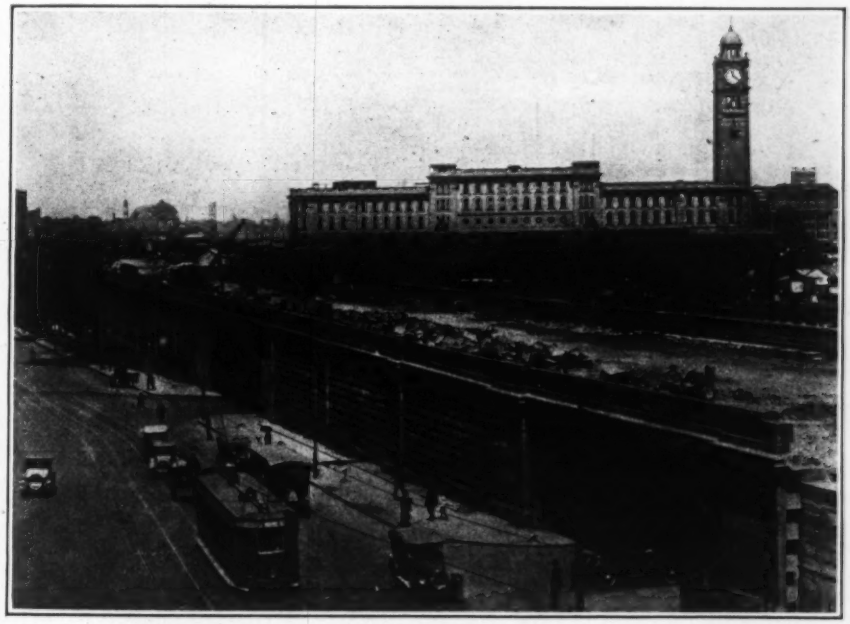


FIG. 2—ELEVATED RAILWAY AT SYDNEY, AUSTRALIA
Viaduct for six-track line passing the Central Station or main-line terminal.

Underground Lines—Twin single-track tunnels are driven for the different double-track lines. At the Goulbourn St. portal there are six tunnels. The two on the north are for tracks to the harbor bridge, while the two in the middle and two at the south are for the west and east sides, respectively, of the city loop. Most of this work has semicircular concrete roof arches of 15-ft. span on brick side and center walls. At certain points, however, there is a flat roof of transverse I-beams, resting on the three walls and embedded in a concrete slab.

Track—Stone-ballasted track having 40-ft. 80-lb. T-rails laid to break joints is the standard construction. Ties are of ironbark, 9x5 in. and 8 ft. long, spaced 18 to a rail length, with the shoulder ties carrying bridge plates 30 in. long to support the joints. Steel tie-plates give the rails an inward cant of 1 in 20. To prevent leakage of current, insulating pads are placed between the tie-plates and the rails. In the underground stations, however, the ties are embedded in a concrete floor, the surface of which is kept 1 in. below base of rail at center of tie and then sloped to the drains. For the overhead wiring on open track, steel bridges carry catenary cables from which are suspended the trolley wires of cadmium bronze.

FIG. 3—FLYOVER CROSSING FOR TRACKS

Stations—With the city or rapid-transit railway completed and the suburban lines electrified, all suburban traffic now entering the Central Terminal Station will pass through the new Central elevated station, which, with an electric train, is shown in Fig. 4. It has eight tracks served by four island platforms 520 ft. long, with a maximum width of 33 ft. Platform shelters have concrete slab roofs on pairs of steel columns 12 ft. apart and spaced 38 ft. longitudinally. At each end of each platform are two stairways, for entrance and exit, connecting with subway concourses. These stairways are 7½ ft. wide and have a total rise of 19½ ft. Each platform has also a 3-ton electric baggage elevator, connecting with a 10-ft. subway leading into the baggage

room of the adjacent terminal station. Platforms are of earth fill between brick walls, with concrete coping and asphalt paving.

Underground stations are of different types. St. James Station, 40 ft. below the surface, has two island platforms. City or local trains use the outer tracks while the middle tracks are for trains of the eastern suburban line which diverges south of the station (see Fig. 1). This station is 108 ft. wide, with 28-ft. platforms 520 ft. long. Each platform has one 12-ft. stairway for descending passengers and two 6-ft. stairways for ascending passengers. These stairways open from a concourse 108 ft. square 16½ ft. above the platform and 16 to 18 ft. high, having subway ramps to the streets. The Museum Station, Fig. 5, for two tracks, is 48 ft. wide with an arched roof over the tracks and the 12½-ft. side platforms. Here the rails are about 45 ft. below the surface. Long inclined subways or ramps, with steps at intervals, connect with the streets. Both these stations were built in open cut, with shale down to about the springing line and hard rock below.

Interior walls are lined to a height of 8 ft. with cream-colored glazed tile having moldings of different colors.

FIG. 5—UNDERGROUND STATION AT SYDNEY
Single arch span over two tracks and side platforms at Museum Station. Cut and cover work. Note concrete chutes and haunch bars. Spaces behind station walls are for ramps to street level.

FIG. 6—MUSEUM STATION; SYDNEY CITY RAILWAY
Concrete floor with wood ties. Note the brilliant illumination.

Above this the concrete is given a hard dense surface by spraying two coats of mill-white water paint. All stairways have 12-in. treads and 6-in. risers, and the maximum height for any flight is 8½ ft. Treads are made with a non-slip 1:1:2 mixture of carborundum, sharp sand and cement. The same material is used for the edging of the asphalt platforms. Illumination in the underground stations has an intensity of 4 foot-candles on a plane 3 ft. above the platform. As a result of this brilliant lighting, Fig. 6, favorable contracts have been let for the advertising spaces on the walls. Two circuits provide against entire failure of the lights.

The railway was designed and built under the direction of J. J. C. Bradfield, chief engineer of the Metropolitan Railway and Sydney Harbor Bridge. R. J. Boyd is principal designing engineer; W. Farrow, supervisor of construction; K. A. Fraser and A. Humphries, resident engineers; and M. Myers, chief electrical engineer.

Hudson Bay Railway Progress

In the work on the Hudson Bay Ry. end of track is at Limestone River, the bridge is being built, and line work beyond it will follow. A force of 1,100 men and ten work trains is laying new track and reconditioning old track, 391,860 out of 496,800 ties being renewals. Fills are being raised and widened and cuts widened. Ballasting has been done on 180 miles of track.

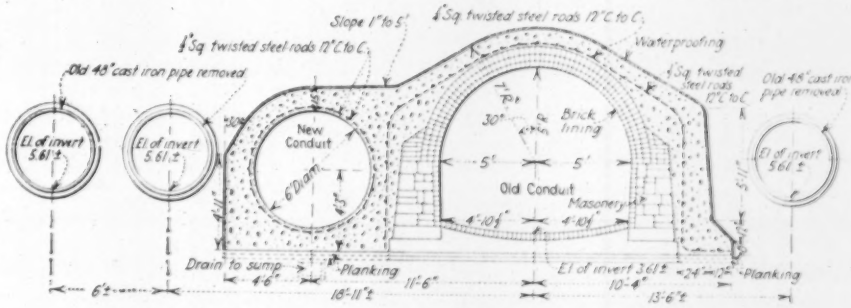
Old Masonry Conduit Reinforced to Support Heavy Sand Fill

Boulevard Built by Increasing the Fill Over Old Conduits—Sections of Old 48-in. Cast-Iron Pipe Found Broken

By Joseph Goodman
Assistant Engineer, Department of Water Supply, Gas and Electricity, New York

CONSTRUCTION of Conduit Boulevard in the Borough of Brooklyn, New York City, on top of four old parallel gravity conduits which formerly carried water from sources on Long Island, required the reinforcing of these structures previous to grading operations and resulted in the removal of three lines of cast-iron pipe which were badly cracked. The work emphasized the necessity for making ample provisions for future heavy fill in the design of large conduits.

These conduits were constructed and maintained in an open cut, 4,600 ft. long, with only light fills of sand, except at street crossings where the depth of fill varied from 9 to 28 ft. The conduits included a brick-lined masonry conduit, horseshoe in shape, 8x10 ft. in size, which was constructed in 1858, and three 48-in. cast-iron pipe lines. One, laid in 1891, was located south of the masonry conduit, and the two other lines, laid in 1895, were north of the conduit. The flow lines of all the conduits were from 2 to 5 ft. below the ground-water table. The cast-iron pipes were all 1 in. in thickness and were cast in the same year that they were installed, under the former City of Brooklyn specifications.



TYPICAL SECTION OF CONDUIT, SHOWING NEW CONSTRUCTION

Fills up to 30 ft. in depth were required in constructing the boulevard, and computation showed that neither the three 48-in. cast-iron pipe lines nor the 8x10-ft. masonry conduit would be strong enough to support more than a 9-ft. fill, if arch action of the superimposed material was ignored. It was then decided to reinforce the masonry conduit for a distance of 3,550 ft., where this depth of fill would be exceeded, and to replace two of the 48-in. cast-iron pipes with a 6-ft. circular reinforced-concrete conduit as shown in the accompanying sketch. The two cast-iron lines were to be retained for possible emergency service.

While the masonry conduit was being reinforced and the new concrete conduit was being constructed, it was found that some of the north cast-iron pipes were cracked. Water was found to be leaking from the second northerly pipe line as well as from the pipe line on the south side of the masonry conduit.

The cast-iron lines were then taken out of service and the interior of 2,000 ft. of the southerly line was examined. This examination showed that 59 lengths of pipe were cracked, generally at the graded street crossings. In the heaviest fill all pipes were cracked, both at top and bottom, for a distance of 200 ft. Decided depressions in the top of the pipe were found. In one case the vertical diameter measured only 3 ft. 7 in. Nearly all the cracks found were from $\frac{1}{16}$ to $\frac{1}{4}$ in. wide and extended along the top for the full length of the pipe. Some lengths of pipe were cracked at both the top and the bottom, while others had additional cracks on the sides. All of the cracks were old and in one case willow roots were found growing through them for a distance of 2 or 3 ft. into the pipes.

Internal examination of the most northerly line showed it to be in a better condition than the south line, with only 11 lengths cracked in 3,500 ft. of pipe. It is probable that additional pipe was cracked at the bottom, but an accurate determination of this could not be made because of the coating of tubercles and sand. Only 32 lengths out of a line of about 3,400 ft. long were found cracked in the north line adjacent to the masonry conduit. These cracks extended from one-half to the entire length of each pipe. This number is exclusive of about ten lengths of pipe which were broken during construction to facilitate their removal.

From an analysis of these conditions it appears that sand fills of more than 13 ft. will probably cause the failure of 48-in. pipe, 1 in. in thickness. The work described was done by the Department of Water Supply, Gas and Electricity of New York City, of which the writer is in charge of the Division of Investigation, Designs and Statistics.

This Year's Airplane Mapping Is Extensive

The Army Air Corps is doing considerable airplane mapping this summer. Several aerial survey detachments, each composed of a commissioned officer of the Army Air Corps, who is a photographic pilot, and an enlisted photographer, were authorized earlier in the year by the War Department to assist the U. S. Geological Survey in carrying out an extensive program during the present calendar year in mapping areas in various states. One detachment will photograph areas in Maine, New Hampshire and Vermont, approximating 8,000 sq. miles, the mapping in Maine being especially valuable as a great portion of the area has never been adequately mapped and existing maps are old and somewhat obsolete. Another detachment will operate on 4,000 sq. miles in Illinois, and later will photograph areas in Michigan and Wisconsin; a similar survey was carried out last year over about 9,000 sq.miles in these three states. Another group is undertaking an aerial photographic survey of the Rio Grande River from Roma, Texas, to the Pecos River, the route of the proposed All-American Canal, and the channel of the Tia Juana River. Each aerial survey detachment is equipped with a tri-lens camera and accessories, and is furnished with two special photographic planes, one active, one reserve.

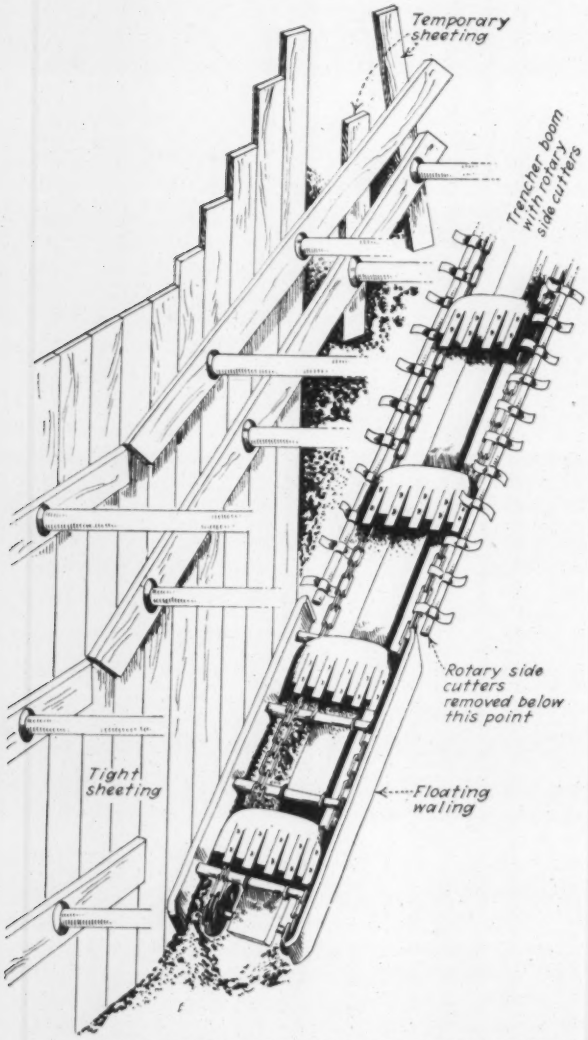
From Job and Office

Hints That Cut Cost and Time for the Contractor and Engineer

Floating Waling on Trencher Boom Speeds Wet Job

By A. M. Rawn
Assistant Chief Engineer, Los Angeles County Sanitation Districts

THE inexpensive attachment to a trencher boom shown in the accompanying sketch changed a trench job in wet running sand from a losing proposition for the contractor to one on which he could make money.



SKETCH SHOWING ARRANGEMENT OF WALINGS

The job was the excavation of a sewer trench, 16 ft. deep and 55 in. wide in which water-bearing material was unexpectedly encountered at a depth of 10 ft. The material was so softened that it flowed in easily through cracks in the sheeting and boiled up in the trench bottom permitting the sides to cave if not firmly and tightly sheeted.

The contractor found himself in the wet formation almost without warning and his operations promptly slowed down from 150 ft. per day to less than 20. However, prompt reorganization and the use of the floating walings increased the trench footage to 100 ft. a day within 4 days' time.

In connection with the floating walings used on the trencher boom, walings that hold the sheeting on the sides of the trench are first put in in an inclined position as shown in the sketch. As the digger moves ahead the sheeting is driven down to compensate for lost penetration, short temporary sheeting is added and the sloping walings are brought more nearly to their final horizontal position. At each stop the temporary sheeting is moved ahead, the full-length sheeting is driven down and the position of the inclined walings adjusted.

The outer faces of the floating walings are set in toward the trench center line a distance equal to the thickness of the sheeting from the outer sweep of the side cutters and the driven sheeting cuts the material below the waling into the buckets. The trenching machine must be kept perfectly level or the boom waling will bind.

Perhaps the most important requirement in the successful use of the scheme is that the crew must be carefully organized and trained. That is, the crew must be trained to do the necessary things immediately when the machine stops. Certain men place gravel in the excavated base; others take care of the walings; others the sheeting, both temporary and permanent; still others spade down excess material that clings to the floating walings, and others remove and replace the temporary jacks. All this must be done promptly or cave-ins result. Little can be done while the machine is moving and much has to be done the moment it stops.

The machine described, with slight modifications, has been used by two contractors, Thomas Kelly & Sons, and the Haverty Co., while carrying out work for the Los Angeles County Sanitation Districts.

Building Construction Troubles

SOME typical troubles encountered in building construction were noted by H. J. Burt, consulting engineer, Chicago, in an address before the Concrete Reinforcing Steel Institute. They were quoted from daily report sheets. Note the unauthorized use of rejected bars in items of June 1 and Aug. 31.

May 12. Found steel in four footings inverted; error in setting diagrams; corrected, 3 men, 6 hours, delayed concreting one day.

May 28. Truck load of bars stuck in mud half-mile from job. Steel setters off half day.

May 29. Three basement spirals missing, replaced by 3, 4 and 5 from first story.

June 1. Inspector reports carload bars from mill failed bend test. Rejected.

June 3. Allowed car of rejected bars to be used straight. Stock bars tested for bending and accepted for replacement.

July 5. Discovered joist rods typical floors ordered ¾-in. round instead of ¾-in. square; third floor set and south half of third floor concreted. Architect orders concrete removed. Contractor wants to leave it and apply load test after 30 days.

July 7. Architect decides to allow beams to be inserted between joists in south half of third floor.

July 18. Replacement rods ¾-in. square received; delay since July 5.

July 25. Fourth floor rods for six joists J-24 missing. Not listed in schedule on architect's plans.

Aug. 3. Mill shipment held for payment sight draft. Owner blamed for not paying June estimate for steel. General contractor advances money.

Aug. 30. Steel dealer claims extra for seventh floor steel, not ordered. This floor not listed on architect's typical floor plan, though shown on elevations. Bought from outside stocks. Adjustment deferred.

Aug. 31. Six bent rods broken; discovered rods previously rejected had been used.

Sept. 1. Waiting for gravel.

Sept. 10. Roof forms completed. Received revised plans of pent house and new stair first to second floor. Mixer broken down.

Sept. 12. Finished setting roof steel. Found 122 bars left over; 10 bent bars identified as belonging to G-7, all typical floors. Cut into G-7 and found one straight and one bent bar missing. Architect's drawings show eight on schedule, and on details show six in a beam 12 in. wide. Steel billed from schedule; setting diagram made from detail.

Sept. 15. Architect checks strength and decides G-7 strong enough.

Simple Scheme Used in Placing Concrete on Malibu Bridge Job

By Ralph Twaddle
Works Engineer, Gutleben Bros., Los Angeles, Calif.

WHEN the construction program was laid out on the 17-span concrete girder bridge over Malibu Creek in Los Angeles County, because of law-suits with the owner of adjoining lands the contractor was instructed to devise some scheme whereby all construction operations and piles of material could be kept within the limits of the highway right-of-way, which is here 80 ft. wide. This was successfully and economically done.

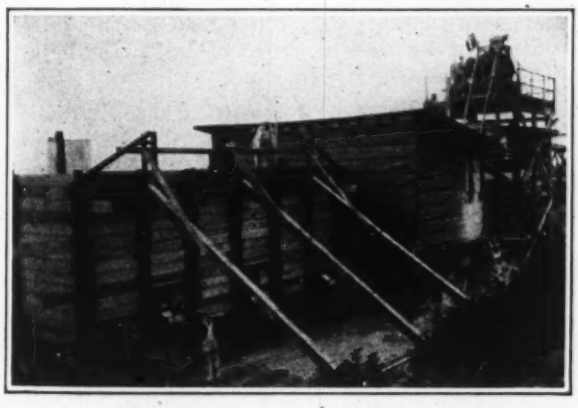


FIG. 1—MATERIAL AND CONCRETE PLANT
Sand and gravel bunker at left, then the cement house, and beyond the mixer, served by a skip rising from under the cement house.

The material bunkers were built with entrances on the roadway pavement at one end of the bridge. Materials went out of these bunkers through bottom bin gates into a batch car that was pushed by hand about 30 ft. and there dumped into the mixer skip. The cement house was placed directly over the mixer skip and charges of cement were released by the operation of a lever, through a canvas irrigation hose leading down into the skip. When a complete batch of dry materials had been delivered into the skip it was taken up over an inclined track to a 14-cu.ft. mixer about 30 ft. above.

From the mixer concrete was discharged into a floor hopper and then into a specially built hopper car driven by a Ford engine on an industrial track. This track ran the entire length of the bridge at an elevation approximately 10 ft. above the deck, permitting the depositing of concrete to all parts of the structure from piers to

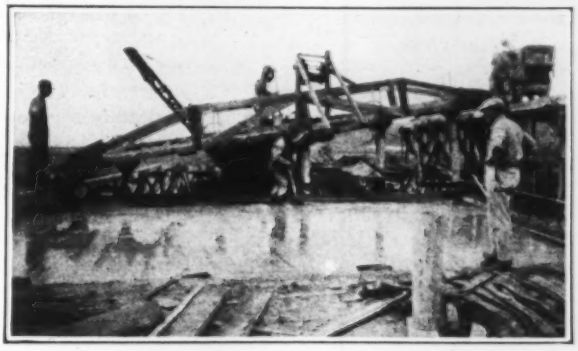
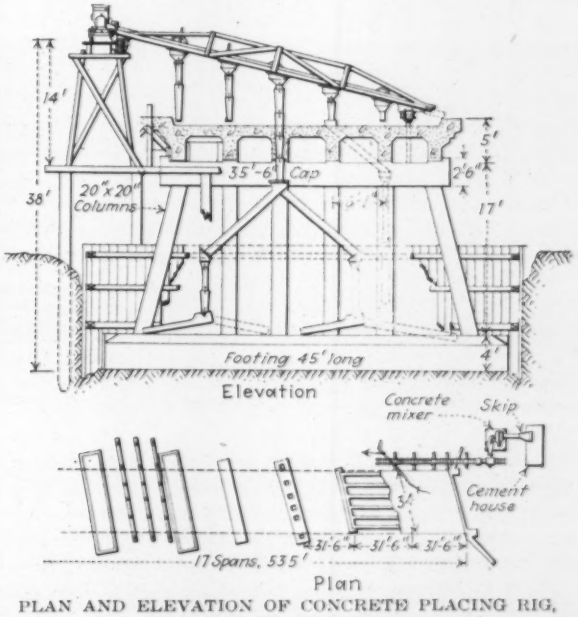


FIG. 2—POURING THE DECK OF THE MALIBU BRIDGE
Concrete delivered by Ford engine on track at right. Footings and bents were also poured with this same setup.

bridge railing by means of a movable chute. This chute was supported by two wooden trusses spanning the full width of the bridge and arranged to be moved along, from time to time, as the work progressed. One end of this truss traveled on the industrial track trestle and the other on the bridge falsework. The spouting arrangement, as shown in the accompanying illustrations, was laid out to make it convenient to deliver to all parts of the work with a minimum rearrangement of equipment.

The chutes were placed on a flatter slope than would otherwise have been used by reason of the addition of 3 per cent, by weight, of diatomaceous earth, used to facilitate the flow of the concrete mix. The result was



PLAN AND ELEVATION OF CONCRETE PLACING RIG, MALIBU BRIDGE

a highly satisfactory concrete job, free from honeycomb and with an average 28-day strength of slightly over 4,000 lb. per square inch.

The resident engineer for the county, C. A. Turner, proportioned the mix and conducted frequent slump tests. His co-operation is gratefully acknowledged.

Dictaphone Used for Sounding Work in New York Harbor

ON THE hydrographic work constantly under way in New York Harbor and the adjacent navigable waters, the U. S. Engineer Department in charge of the work has developed a method of utilizing a special Dictaphone installation for automatically recording soundings. This method permits the work to be carried on by fewer men, and with greater speed and accuracy than with ordinary sounding methods. The idea was conceived by the U. S. engineers who turned it over to the technical department of the Dictaphone Co. for development. The equipment consists of a Dictaphone machine equipped with an electrical recorder instead of the usual mouthpiece, a switch box, an amplifying unit and a number of telephone lines and transmitters.

FIG. 1—PONTOONS EQUIPPED FOR SOUNDING WORK IN NEW YORK HARBOR

The six leadsmen, stationed about 15 ft. apart, speak their soundings into the transmitter hung about their necks. It is recorded on the Dictaphone record at the switchbox on the center barge. Chief of party is at right.

Rowboat sounding methods were discarded several years ago and each of the surveying or sounding parties equipped with three flat pontoons, each 25 ft. long and 10 ft. wide, rigidly connected together in tandem and affording a floating platform about 83 ft. long. This pontoon drifts with the current and is controlled by a 40-ft. launch attached to its upstream side and by outboard motors placed at each end. The latter tend to hold the barges normal to the thread of the current when wave wash and wind action are excessive. Two leadsmen are assigned to each pontoon. They are stationed 15 ft. apart and take soundings continuously as the pontoon drifts. Either two or three transits on the shore periodically determine the position of the pontoons.

Before the adoption of the Dictaphone, a recorder was used on each barge to take down the soundings of each two leadsmen. The recorder also listed the time intervals between transit locations, the number of soundings between such locations being arbitrarily spaced when the soundings were plotted. This introduced one of the major inaccuracies into the old method. Under the old method, too, the leadsmen frequently dominated the recorder and were inclined to take readings at irregular intervals. Also each pair of leadsmen sounded independently so that there was little co-ordination of work on the different barges.

The Dictaphone installation eliminates these disadvantages. It automatically records the time intervals between soundings since each record can be reproduced at the same speed at which it was recorded. Under this new method each leadsman must be ready to record his readings when his turn comes. The readings can also be made faster which permits better map spacing. Two recorders are eliminated entirely and the final advantage is that the leadsman's voice can be recognized on the record so that any dispute about a sounding can be checked to the proper source.

From Job and Office

Hints That Cut Cost and Time

FIG. 2—DICTAPHONE INSTALLATION FOR RECORDING SOUNDINGS IN NEW YORK HARBOR

Equipment consists of electric Dictaphone recording machine, special amplifier unit and a switchbox. The switchbox operator and one of the leadsman are shown.

COMPILATION OF DICTAPHONE RECORDS — SHEET NO. 1

LOCALITY ..... RANGE NO. ....
DATE ..... CYLINDER NO. ....
REMARKS .....

SOUNDS	TIME AND FLAG	1 Sector		2 Ennis		3 O'Donnell		TIDE	4 Mike		5 Brand		6		SOUNDS
0	10-58-00	9.2	5.5	1.26	11.9	1.82	14.5	3.7	1.72	14.5	1.80	14.3			0
3100'	White Flag from start	11.1	7.4	1.50	11.3	1.68	13.1		1.88	15.1	1.80	14.3			
1															1
2		12.3	8.6	1.29	9.2	1.68	13.1		1.85	14.8	1.72	13.5			2
3		11.5	7.8	1.48	11.1	1.77	14.0		2.00	16.3	1.68	13.1			3
4		11.2	7.5	1.47	11.0	1.67	13.0		1.68	13.1	1.82	14.5			4
5		11.9	8.2	1.48	11.1	1.88	14.1		1.70	13.3	1.98	16.1			5
								3.6							
3100'	Yellow	11.9	8.3	1.40	10.4	1.40	10.4		1.65	12.9	2.00	16.4			6
7		12.1	8.5	1.48	11.2	1.48	11.2		1.70	13.4	1.88	15.2			7
8		11.6	9.0	1.41	10.5	1.53	11.7		1.75	13.9	1.92	15.6			8
9		12.5	8.9	1.35	9.9	1.40	10.4		1.68	12.2	1.84	14.8			9
10		11.6	8.0	1.21	8.5	1.33	9.7		1.90	15.4	1.81	14.5			10
3100'	Red	1.00	6.4	1.00	6.4	1.28	9.2		1.85	14.9	2.09	17.3			1
2		9.7	6.1	1.12	7.6	—	—		1.88	15.2	2.09	17.3			2

FIG. 3—FORM TO WHICH SOUNDINGS RECORDED ON DICTAPHONE CYLINDER ARE REMOVED

Vertical scale at left corresponds to scale on Dictaphone. Transit locations, which give the spacing of the soundings, are shown by white, yellow and red flags.

From Job and Office

For Contractor and Engineer

Six leadsmen are used. The three recorders are replaced by one man who operates the switchbox. Each leadsman is supplied with a transmitter hung about his neck. As he makes a sounding he speaks in an ordinary voice into the transmitter as the operator switches his wire onto the Dictaphone. Each leadsman dictates in turn.

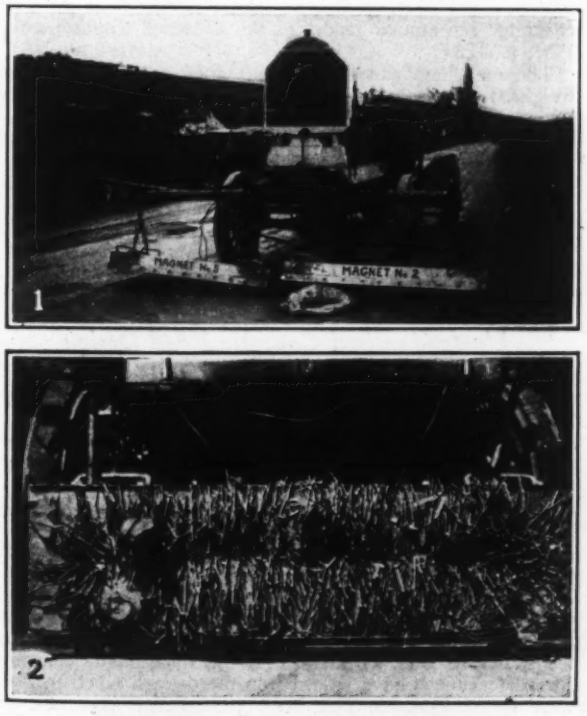
At the end of the day the cylinders are taken to the field office where the readings are transcribed to a form similar to Fig. 3, where the readings are corrected for tide variations and the soundings are ready to be plotted on maps.

A sounding every second is about average with the new method. With the old method, soundings were made at intervals of about 100 ft. parallel to the thread of the tide; but by the use of the Dictaphone it is possible to take about six readings in every 100 ft.

This work is being done by the United States Engineer Department, First District, New York City, under the direction of the district engineer. H. E. Libby is associate engineer in charge of the surveying and charting.

Magnetic Highway Nail Picker

A SET of specially designed electro-magnets mounted on a truck and carried about 2 in. from the surface of the highway, was used to remove nails and other magnetic material from highways in the vicinity of Pullman, Wash. Two 4-ft. magnets were used, sweeping in strips 8 ft. wide and operated by current from a gasoline engine-driven generator mounted on a truck. Each magnet is strong enough to pick up a loose nail at a distance of 6 in. or more. As the magnet is carried within about 2 in. of the ground during operation, it picks up nails which are covered by loose gravel or partially embedded in the road surface.



MAGNETIC HIGHWAY NAIL PICKER
Upper view shows general assembly on truck; lower view shows the source of many a tire puncture.

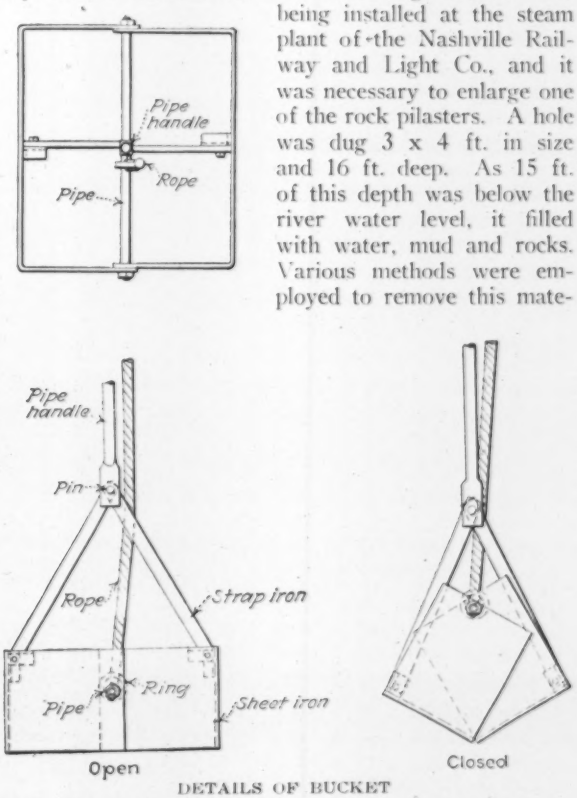
Quantities of nails and other iron and steel pieces were picked up, including spark plugs and a speedometer chain. No particular highway covered seemed to be free from a certain amount of magnetic material although the largest amount was found in city alleys and in the places where buildings had recently been torn down.

The equipment was designed and assembled by H. J. Dana of the Engineering Experiment Station, State College of Washington, Pullman, Wash.

Improvised Clamshell Bucket Makes Deep Hole

By H. O. Stiles
Nashville, Tennessee

MUD and rocks were recently successfully removed from a deep hole being excavated by means of an improvised clamshell bucket. Two large boilers were being installed at the steam plant of the Nashville Railway and Light Co., and it was necessary to enlarge one of the rock pilasters. A hole was dug 3 x 4 ft. in size and 16 ft. deep. As 15 ft. of this depth was below the river water level, it filled with water, mud and rocks. Various methods were employed to remove this material without success, until the type of clamshell bucket shown in the sketch was developed.



DETAILS OF BUCKET

This bucket is lowered into the narrow hole, in an open position, by forcing it down with the pipe handle and at the same time releasing any tension in the rope. By pulling on the rope the bucket will close and any material in the bucket is confined and raised to the surface.

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

A New Method for Developing Irrigation Projects

Sir—Recent years have brought out much literature on the question of what is the matter with irrigation. "The matter" seems to be any one of a number of things, depending upon the particular experience or point of view of the diagnostician. We hear of excessive, even of wildly extravagant construction costs; of alkali or rising groundwater elevation requiring expensive drainage; and of adverse conditions of ground, climate or market not apparent until after several years' operation. Some individual colonists appear to have acted on the assumption that it was only necessary to turn on the water, and nature would do the rest while they did the resting.

There exists in the United States unoccupied irrigated land equal to ten years of demand at the rate of movement of settlers to this land, under our present lack of a colonizing system. While extravagant costs, operating difficulties, fatuous politicians, and over-production, all contribute to the answer, the writer does not remember to have encountered any recognition of what may very possibly be the principal cause—our total lack of intelligent and sympathetic colonization.

A potential settler, attracted by rosy come-on literature and the picture of the beautiful maiden, with exuberant charms, amid an exuberant crop of something, ventures within the radius of action of the salesman and is lost. The salesman grabs the possible agriculturist, whisks him to the most glorious spot on the project, has him talked to by "the Secretary of our Chamber of Commerce," and otherwise hypnotizes him out of a first payment and a signature. Thereafter the victim is alone and friendless except for the rather long-range and academic interest of our Department of Agriculture. He usually has or can get his hands on enough capital to struggle on for a year or two and make a few more payments; but too often he has finally to throw up his hands.

Consider now a wholly different picture.

A large percentage of the labor employed in constructing irrigation works is of the unskilled class, or of the class whose previous experience has been in agricultural employment. Let the project manager go to the labor markets, preferably in the East, where there is an influx of such labor from foreign countries. Let him thoroughly explain his purpose, to secure laborers who aspire eventually to become landed proprietors. If adequately done it should attract large numbers, not only of native Americans and even failures from other projects, but particularly foreigners from agricultural lands or districts.

A word regarding the latter class. Invariably they have a reverence for land ownership, a reverence and intense desire hardly understandable in a country where land has always been free for anyone to take up. They will cheerfully work hard enough and for years enough to acquire it, to make it their own, to be able to pass it along to their children. Ask any farm loan banker which is the best risk, the native American or the foreigner!

Laborers thus assembled would have an interest in the project, eventually to be their own, such that it would be apparent in the spirit and efficiency of their work. They should feel from the first that they are working for themselves. After the construction period the project manager should cultivate a tract, as large as he is able to cultivate with the available labor. Several years of fairly paid employment, and the laborer turned farmer should be able to lay by enough to give him a good financial start. He will be acclimated, will have learned agriculture and irrigation as they apply to the particular location and the prevailing crops. An advance would come when he was adjudged able; he would be assigned a tract of land to work on shares. This would extend his experience and teach him the difference between being merely a good agricultural laborer and being the proprietor of a business. From that to complete ownership and an ultimately paid-up farm is but a matter of steady progress.

Now for the startling feature of the program: Through it all, until he becomes a complete proprietor, the colonist should feel that he can withdraw, for any reason, and at no financial loss to himself. The man may have doubts when he starts. He should be free to confess his disability or disinclination at any time. To such a man the project should return the instalments paid, also the value of his improvements (such as buildings or equipment). The project will be a distinct gainer from this policy, for an irrigation project is merely a useless tool until it gets into the hands of the actual cultivator.

The policy outlined will attract prospective colonists and the percentage of failures will be vastly less than under present methods. There will be no hiatus between the periods of construction and cultivation. Profits from the early cultivation might pay the project interest charges, possibly much more. Sales costs, instead of being 20 to 30 per cent, would be practically nothing.

We have hitherto expected the colonist to burn all his boats behind him before trying to see what he could do with the job; now let's help him. Instead of trying to do him let's do for him. The idea of service has spread over most of the country and into many lines of activity; it is worth applying to productive land as it has been to residential.

Newburyport, Mass., August 10, 1927.

CHESTER W. SMITH,
Consulting Engineer.

River Control by Anchored Tripod Dams

Sir—Spencer E. Webb's description of "River Control in the Palo Verde Valley" is most interesting (*Engineering News-Record*, Aug. 11, 1927, p. 226).

Permit me to suggest using "disk anchors" in place of concrete; see annual report of the Chief of Engineers for 1901, p. 2,224.

These anchors can be constructed of any diameter and weight, to suit conditions. Primarily they are intended to be jetted to a "holding" depth into the river bottom. However, jetting is not necessary since the casting can be of sufficient weight to "dig itself in."

I have used these anchors on Mississippi River work and they fully justify their reputation for "staying put."

Kansas City, Mo., Aug. 18, 1927.

F. Y. PARKER,
Associate Civil Engineer,
U. S. Engineer Office.

Unstandardized Concrete Road Design

Sir—For nearly a generation concrete has been extensively used in all parts of the country in the construction of foot walks. During the latter part of this period or about eighteen years, concrete has also been extensively used in the construction of concrete roads. The mixes, methods and thickness used in concrete walk construction are practically the same as they were nearly a generation ago and the results have been almost universally good.

However, when we turn to concrete roads, after eighteen years of extensive and expensive experiments, after an outlay of well over a billion dollars for actual construction within that period we find the concrete road is no nearer standardized today than it was at the outset. One by one the standards which were to establish the slogan "concrete for permanence" have passed into the discard whether they were called Hassam, Granitoid, second-class concrete, or what not, and resort has been to rich mixes, to mesh reinforcement, to bar reinforcement, to thickened edges, to longitudinal joints, and all the while failures are laid to an obsolete type until the wonder grows at the fertility of resources which provides at the psychological moment a new standard free from the faults of the old.

How far apart the ideas of engineers today are as to what should constitute a satisfactory portland cement concrete road can readily be gleaned by a study of a most interesting and instructive article by A. G. Bruce and R. D. Brown, engineers of the U. S. Bureau of Public Roads, entitled "The Trend of Highway Design," appearing in the March, 1927, issue of *Public Roads*.

In forty-four listed states the cross-sections fall into twelve distinct groups ranging from the thickened-edge design through uniform sections to thickened-center design. If these designs represent the engineering judgment of the respective state highway departments, the inquiring seeker after knowledge would be told in Illinois to build with thickened edges, using a 9-6-9 in. Bates design; he would journey to Massachusetts and there he would find that the slab should be of uniform thickness, 8 in. the standard; then he would head south and in Maryland would find that it is the center which should be thicker, the standard being 6-8-6 in. If he has the courage to select one of these sections what thickness would he regard as satisfactory? Iowa shows him 10-7-10; Pennsylvania with heavier traffic shows 8-6-8, and populous New York shows him 7-6-7. About the time he figures that what is good enough for the Empire state ought to stand anywhere, he listens to an address by J. S. Bixby, Division Engineer of the New York State Highway Department at Poughkeepsie and hears this disturbing comment on thickness:

> "If the Bates, Pittsburg and Arlington tests give a true indication of concrete road performance under actual highway conditions, and if this survey is sound, we have, if you please, what may be called a critical concrete depth of approximately 7 in. for average and present conditions of traffic. But this is not all, for though we may all agree on a critical concrete depth of 7 in. multiplication of evidence shows that pavements 1 in. thinner will not stand present truck traffic, and if all pavements substantially thinner than 7 in. are deficient, how can we give a 7-in. road slab a greater safety factor than unity if we consider the road slab as an engineering structure? If a 7-in. road slab has a safety factor of only one, is there any warrant for investing millions of dollars in concrete of this depth or slightly deeper?"

A few years ago Illinois' practice of using a rich mix of 1:1½:3 was widely heralded as the last word on concrete mix and yet the summary shows only two out of 44 states using this mix, the prevailing practice giving rise to ten groups of states, each using a different mix. The inquiring engineer would be puzzled to know whether Illinois is wasting cement by so rich a mix as 1:1½:3 or if Wisconsin is taking dangerous chances by using as lean a mix as 1:2:4.

If the inquirer is puzzled over cross-sections and mixes he is absolutely lost in the metal maze of reinforcement standards. Seven states report "no steel"; thirteen report "dowels only"; but twenty-three report reinforcement. Now the humble inquirer must first decide whether the twenty negatives or the twenty-three affirmatives are right. If he decides for the affirmative his troubles have only just begun for seven of these use bar reinforcement, nine use mesh, seven use either. If he hurdles this one and inquires as to the weight of metal he finds that bars are used all the way from 28 lb. to 95 lb. per 100 sq.ft., no two states having identical requirements; and while the mesh ranges from 25 lb. to 66 lb., only two states require the same. He perhaps makes his purchase and endeavors to decide where to put it. He turns again inquiringly to the states and finds that some states place it 2 in. from the top; some 3 in., some 4 in., some 5 in., while some say 2 in. from the bottom and some say either top or bottom.

Shall the engineer call for transverse expansion joints? Thirty-three states say yes; but fifteen states, among them such progressive states as Illinois and Missouri, say no. Longitudinal joints? Yes, say thirty-four states, eager to forestall the longitudinal crack by putting one there at the outset. No, say seven states, including North Carolina and Alabama. How far apart should the transverse joints be spaced? Oregon says 25 ft.; 20⅔ ft. says Minnesota. Should dowels be used in longitudinal joints? No, say New York and New Jersey, among others; yes, say Indiana, Michigan and others.

Originally the principal argument advanced for unsurfaced portland cement concrete roads was low first cost. Since then rich mixes, metal reinforcement, dowel joints and heavier designs have increased cost and have not removed the one supreme limitation of portland cement concrete's usefulness in paving—namely, its deformation and disintegration under the stresses set up by moisture and temperature changes. Why, instead of defying nature by building more strength against an irresistible force, is not more attention given to protecting the concrete from moisture and temperature changes?

Columbia, S. C., Aug. 9, 1927. WALTER E. ROWE, Dean, School of Engineering, University of South Carolina.

Registered Engineers in Michigan

Sir—On p. 26 of your issue of July 7 appeared an article entitled "Registered Engineers Win Suit" in which you attack my character and publish statements which are false.

I was never employed by the Macomb county drain commissioner as drain engineer. I was never tried for a suit of practising without a license. I was never discharged from the employ of the drain commissioner. No registered engineers filed any protest to my work with the county board of supervisors. There is no truth in the statement that I was in responsible charge of the drain work while my employer was in California on his vacation. In general the entire article is a mistatement. PAUL BENZ.

Mount Clemns, Mich., July 12, 1927.

Sir—In answer to your questions I can state as follows:

(1) Mr. Benz was never employed by me as drain engineer but was loaned to my office by his employer, Walter J. Lehner, on a part-time basis to organize an engineering department for me. During all of the time he has been with me he has never been off the payroll of his present employer, nor did he ever sign any plans or surveys or in any other way act as a principal.

(2) He was never tried for practising without a license. It is true that he was accused of this, but no one is guilty before he is convicted, and whereas Mr. Benz was willing to stand immediate jury trial on the charge, his accuser, R. T. Litheridge, dropped the case because he was unable to substantiate the charges.

(3) Mr. Benz was never discharged from this office.

(4) The protests filed with the county board of supervisors were made by the aforementioned R. T. Litheridge, who is not a registered engineer. The bill of complaint, which was not made directly against Paul Benz, but in which he was mentioned as being in my employ illegally, did not make any charges against him, and his accuser refused to answer any questions on this subject at the investigation because he had been forced to drop the charges in court a few days previous.

Mount Clemens, Mich., July 28, 1927. EDWARD D. MILLAR, County Drain Commissioner.

[This matter came to our attention originally through press dispatches, and replies to inquiries appeared to support the statements. It was of direct interest in view of the growth of the movement for the registration of professional engineers.

No reply has been received to letters addressed to Mr Litheridge in regard to the inquiry whether he agrees with Mr. Millar's statement as to the reason for dropping the case. In noting the exoneration of Mr. Benz, a local paper stated that a special committee of the board of supervisors presented a report which was "mildly critical" but: "clearing county drain commissioner Edward D. Millar, county engineer Walter Lehner, and Paul Benz, drain engineering employee, of all intentional violation of the spirit and letter of a county resolution relative to the payment of drain engineering fees and a state law governing the employment of engineers."

We are glad to publish the above letters as throwing light on the situation and correcting any inaccuracy.—EDITOR.]

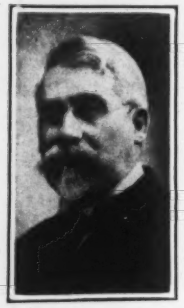
News of the Week

Current Events in the Civil Engineering and Contracting Fields

J. C. Bland, Retired Railway Bridge Engineer, Dead

Retired in 1923—Had Served Almost 30 Years as Bridge Engineer of Pennsylvania Lines West

J. C. Bland, who retired from active service as bridge engineer of the Pennsylvania Lines West in 1923 after almost thirty years in that position, died at his home in Atlantic City, July 16. Mr. Bland had been with the Pennsylvania R.R. long before he was made bridge engineer of the lines west, having begun his service with that railroad as assistant engineer on construction from 1871 to 1874.



During his association with the Pennsylvania railway bridge construction grew from a sharply competitive industry with little of that close control now exercised by railways through their own bridge engineers, to a high degree of technical perfection. In this development, Mr. Bland had no small part. In 1894 he gained considerable note through the successful carrying out of the rebuilding of the Ohio River bridge at Cincinnati on the Southwest line of the Pennsylvania system. This work involved the special complication introduced by the necessity of keeping open a 200-ft. width of channel through the falsework of the main span. The fact that the new bridge was of pin-connected design is especially interesting inasmuch as Mr. Bland in later years was the principal exponent of riveted bridge construction, which culminated in his design of the 640-ft. riveted channel span of the Louisville bridge twenty years later.

During or just after the Cincinnati rebuilding, Mr. Bland was appointed principal engineer of the Pittsburgh, Cincinnati, Chicago & St. Louis Ry. (the Panhandle), in charge of bridge work. Five years later he advanced to engineer of bridges for the Pennsylvania Lines West of Pittsburgh, including the Panhandle and the Fort Wayne roads. This position he held continuously until his retirement Feb. 1, 1923. The following paragraphs taken from *Engineering News-Record*, March 15, 1923, p. 490, is an appreciation of his work written at the time of his retirement.

During this time (1902 on) Mr. Bland was carrying on an extended series of test of full-sized bridge compression members, begun some years ealier. The results, reported by his assistant, C. P. Buchanan, in *Engineering News* of Dec. 26, 1907, commanded universal attention, and together with the discussion of the Quebec bridge failure of the same year supplied the stimulus to the renewed study of column strength during the next decade.

Two interesting bridge problems arose a short time afterward. One was the combined replacement and reinforcement of the Ohio River bridge of the Panhandle at Steubenville, a structure over 20 years old. The other, a formidable undertaking, was the reconstruction of the Ohio Connecting Ry. bridge over the Ohio River, just below Pittsburgh. This structure included a 525-ft. and a 400-ft. channel span and a long series of shorter deck truss spans, and was further complicated by a curved approach over the yards of the Fort Wayne line on the north bank. It carried a phenomenally heavy traffic, trains following each other in a continuous series throughout the day, and the service required that traffic should not be interrupted or materially reduced. The reconstruction involved bold and novel procedure throughout, such as the erection of the large channel span around the old span by cantilevering out from either pier, using the halves of the back-channel span as anchor arms, and the replacement of the minor spans by successful erection alongside and rolling in. The successful completion of this work without incident and without traffic interruption represented a notable achievement. With

(*Concluded on p. 322*)

Mississippi River Report to be Ready by December

The Mississippi River Commission announces that its report upon the recent flood and the methods of providing against a repetition of the disaster will be completed by the time Congress convenes in December. The Commission has 32 engineer officers and 124 civilian engineers engaged upon the study.

Engineering Fifty Years Ago

From *Engineering News*, August 25, 1877

Dr. C. W. Siemens, in England, estimates that the falls of the Niagara do as much work in a year as 206,000,000 tons of coal, at the rate of 4 lb. per horsepower in an hour. He considers that the falls might drive an electrical machine, the current of which might traverse a copper rod. He asserts that a rod 3 in. in diameter would transmit 1,000 hp. as far as 30 miles, and that at the end the electricity could be used to create motion or light. For the latter there would be sufficient to equal 250,000 candles.

Tentative Agreement Made on Contractors' Equipment

General Contractors and Revenue Bureau Near Agreement on Depreciation

A tentative agreement regarding alternative methods of computing depreciation on contractors' equipment for income tax purposes has been reached by officials of the Internal Revenue Bureau and the Associated General Contractors of America. Efforts to reach such an agreement have been under way for the last two years, in order to standardize the practice and replace the varying methods, sometimes conflicting, which formerly were allowed by agents of the bureau in different districts.

The tentative agreement will be placed before the board of directors of the Associated General Contractors at its meeting in Birmingham, Oct. 17 for ratification, after which it will be placed before the Commissioner of Internal Revenue for his approval.

Five alternative methods, the choice to be with the taxpayer, are embodied in the tentative agreement. They are as follows:

First: The old straight line method of depreciation which consists in estimating the useful life of each piece of equipment in years, and charging off a uniform portion of the initial cost during each year of the estimated useful life. That is, if a piece of equipment will last four years, one quarter of its cost or twenty-five per cent is charged to depreciation each year whether the equipment is in use or is idle.

Second: The unit of work method of depreciation, which consists in estimating the units of work which a piece of equipment will do before it becomes useless through wear or for other cause, then dividing the initial cost of the equipment by this number of units of work to find the cost of equipment consumed in doing one unit of work. These units may be tons, cubic yards, hours or any other suitable unit of measure. Thus, if a concrete mixer will do twenty miles of paving work before it is worn out, one-twentieth or five per cent of its initial cost is charged to depreciation for each mile of paving construction which it does. With this method depreciation is not charged on idle equipment but is charged on all equipment in use, that is depreciation is charged for income producing equipment but not for non-income producing equipment.

Third: The job basis of depreciation which consists in charging the difference between first cost of a piece of equipment and its actual or estimated salable value at the end of the job against the

job for which the equipment was purchased. This method applies to special equipment purchased for a particular job, and for which no further use can be definitely predicted when the job for which it was purchased has been completed. The method also applies to contractors who make a practice of selling all equipment at the completion of each job and buying new equipment for the next contract.

Fourth: Composite rate of depreciation determined by listing entire equipment with cost and item rates of depreciation (either straight line or unit of work item rates) and then determining an average rate for the entire equipment by dividing the total of the item amounts of depreciation by total cost of equipment. When a composite rate of depreciation is used there will be no charge to profit or loss when items of equipment become useless or obsolete, or otherwise are abandoned. The average rate is supposed to provide for all such contingencies and if one item does not last as long as estimated it is presumed that some other item will be useful for a longer time than was estimated and the loss on one will be balanced by over-depreciation of the other. The property account includes all items still in use at initial cost. When an item is disposed of its initial cost is taken out of the property account and the initial cost less actual salvage value is also taken out of the depreciation reserve. That is, it is assumed that the depreciation reserve contains the full amount of actual depreciation on the item. As an illustration, say that there are two items of equal value each having an estimated life of five years, or 20 per cent depreciation on each is included in the average or composite rate. One item is scrapped at the end of 4 years and the other at the end of 6 years. No loss is written off for the 4-year item, but the composite rate of depreciation allows 20 per cent for 6 years or a depreciation of 120 per cent of the cost of the 6-year item.

Fifth: The job basis can be used for special equipment and if this equipment is not sold but is retained by the contractor for use in possible future jobs, the balance of its cost may be depreciated either over the estimated remaining years of useful life or over the estimated remaining number of units of work of which the equipment is capable.

Bids Called for Abutments of Two Large Bridges

The Port of New York Authority is calling for bids on the construction of the abutment and placing the earth fill for the plazas of the two bridges which it is building across Arthur Kill between Staten Island N. Y., and the mainland in New Jersey. The work for each of the four plazas will be a separate contract. Bids will be received up until September 12.

Progress on the new bridges was described in our issue of August 18, page 282.

Cross-Connections in New Jersey May Be Prohibited

Prohibition of not only cross-connections but also any physical connection between an approved public water supply and any other water supply, except as noted further on, is the gist of a proposed new chapter of the State Sanitary Code of New Jersey, scheduled for action at the meeting of New Jersey State Board of Health on Sept. 13. The new chapter was submitted to the board on April 21, 1927, by H. P. Croft, chief of the bureau of engineering, and was supported by Mr. Croft in a lengthy communication to the board dated June 28.

The new chapter would prevent "any cross-connection, by-pass, valve or auxiliary intake, or other similar device which permits or may permit any flow of water into an approved public potable water supply from any other supply of water.....unapproved by the" state department of health or not treated in accordance with its regulations. It permits physical connections with another approved public potable supply and with a [private] approved potable supply "regularly examined as to its purity by those in charge of the approved potable public water supply with which the connection is to be made" and also regularly examined by the "state department of health," provided there shall be no connection between the approved private potable water supply and water supplied from a source polluted or subject to pollution."

The new chapter would become effective immediately after its adoption, except that the time of discontinuances of physical connections may be extended to Jan. 1, 1928, "when the physical connection between an approved public potable water supply and any other water supply includes two gate valves with indicator posts, two check valves of the special Factory Mutual Fire Insurance design, or equivalent, with drip cocks and gauges for testing, all located in a watertight construction accessible for ready inspection."

The Manufacturers' Association of New Jersey has requested an amendment to the new chapter that would permit cross-connections for fire fighting purposes if protected by the double check valves and accessories described just above, provided that "at least quarterly tests for tightness and annual internal examination and cleaning be made jointly by accredited representatives of the owner [of the cross-connection] and of the municipality, and that the results of these tests and inspections be reported to the state department of health." The proviso, Mr. Croft states in his report already mentioned, "demonstrates that such an installation is not absolute protection."

In substance, the proposed amendment to the sanitary code is an enlargement of an earlier prohibition of cross-connections, the enlargement including by passes, etc., as stated above. The earlier prohibtion of cross-connections was in the form of a resolution, adopted by the board Oct. 6, 1925, to be effective Jan. 4, 1926, but amended March 2, 1926. The amendment of the resolution extended the date of discontinuance to Jan. 1, 1928, but applied only to cross-connections guarded by two check valves of the Factory Mutual type—a proviso that the board is now asked to include, without time limit, in the proposed amendment to the Sanitary Code.

Formal Start of Big Bridge

The formal ceremony of breaking ground for the Fort Washington-Fort Lee Bridge at New York is to be held on September 21. Ground will be broken simultaneously on both the New York and New Jersey shores while the speakers will be on the steamer De Witt Clinton anchored in midstream at the point where the bridge will cross the river. Two contracts for this work have been let, the first in April of this year, and the preliminary work for the piers at the New Jersey end is well under way.

Saluda Dam Contract Let

Contract for the great earth-fill dam of the Lexington Water Power Co. on the Saluda River in South Carolina has been let to the Arundel Corp. of Baltimore, Md. The estimated cost of the work is placed at $6,000,000. A license for the construction of the project was issued by the Federal Power Commission in July. The Lexington Water Power Co. is a subsidiary of the General Gas & Electric Corp. The work is to be carried on under the direction of the W. S. Barstow Management Assn., Inc. Murray & Flood, New York, are the engineers.

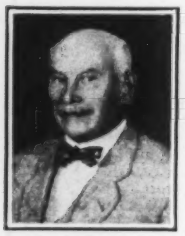
Ask Large Federal Expenditures on Mississippi River

A program calling for the expenditure of $100,000,000 annually by the federal government on flood control and river regulation in the Mississippi Valley has been presented to the Mississippi River Commission by the Mississippi Valley Flood Control Association. The association's plans call for the construction of levees on all streams where they are considered necessary by the Corps of Engineers, construction of spillways, improvements for the benefit of navigation, reclamation of swamp areas and the use of land unsuited for agricultural purposes for game preserves, reforestation of denuded forest areas, and the construction of dams for water storage and for the development of power. The program can be completed in ten years, according to the report.

Governors of the states of Louisiana, Arkansas and Mississippi, at a recent meeting at Baton Rouge, recommended that the federal government assume the bonded indebtedness of the local levee districts and take over the responsibility of reconstructing all the damaged levees.

Judge Gary, Head of Steel Corporation, Dies

Judge Elbert H. Gary, chairman of the board of the U. S. Steel Corporation, died at his home in New York City on August 15. He was over 80 years old at the time of his death and had been in ill health for some time.



Judge Gary was born near Wheaton, Ill., in 1846, educated in the local public schools and was a student in Illinois University, when in 1864 he ran away from home to enlist in the army for the Civil War. Discharged from the service on account of his youth, he entered the Union College of Law at Chicago and graduated in 1868. After a short time in private practice, he was elected a judge in DuPage County and served for two terms in that capacity.

Beginning in 1892, Judge Gary gave much legal advice to the steel wire industry and later to the steel industry concerning the amalgamations then in progress. With the formation of the Federal Steel Company in 1898 he became its president. When the company became part of the United States Steel Corporation, which was formed in 1901 with Charles M. Schwab as president, Judge Gary became executive head of the company. This position he held until in 1903 when W. E. Corey became president and he was appointed to the new position of chairman of the board of directors. In the 26 years which have elapsed since the formation of the U. S. Steel Corporation, Judge Gary has been largely responsible for its reaching its present dominating position in the industry.

Housing Bill Passed by New York Board of Aldermen

Acting upon Mayor Walker's plan for obtaining land upon which to build modern tenements in the slums of New York City by the "Excess Condemnation" method (*Engineering News-Record*, Aug. 4, 1927, p. 195) the Board of Aldermen on Aug. 22 passed a bill which contains some changes from the original plan.

The bill, which is subject to approval by the Board of Estimate and a referendum vote in the November elections, provides that the excess land shall be leased exclusively for housing purposes; that the leasing authority shall be retained by the Sinking Fund Commission; and that excess land shall be leased only to the highest bidder.

The mayor's original plan provided for using the ground floors of buildings erected on this excess land for commercial purposes and placed the leasing authority in the hands of the Board of Estimate, with no restrictions as to public letting or highest bidders.

Ruling Under University Heights Zoning Ordinance Invalid

Exclusion from a single-family residence district of an orphanage on the cottage plan was held by the U. S. Circuit Court of Appeals, Sixth District, to be unreasonable (Village of University Heights vs. the Cleveland and Jewish Orphans Home) in a decision given in full in the *U. S. Daily* (Washington, D. C.) of Aug. 5.

The preamble to the zoning ordinance on which the attempted exclusion was based states that "the village of University Heights is a residential suburb having no steam railroads or industrial establishments within its limits . . . and that it is the desire of the village to preserve its residential character, which is in the interest of the health, safety, convenience and prosperity of the citizens of the village." The site for the proposed orphanage is in a U-1 district in which an orphanage may not be placed unless (1) under four stated physical conditions not existing in this case or (2) in a location declared by the Village Planning and Zoning Commission, after public notice and hearing, to be one where an orphanage would "substantially serve the public convenience and welfare" and "not substantially and permanently injure the appropriate use of neighboring property." The orphanage site did not comply with any of the physical conditions and the commission refused the permit under the other exception, although it did not find that the "proposed buildings" would violate "any regulation" as to "height, area, construction or set back lines." It did hold that the "public convenience and welfare would not be served by the intended use."

After referring to the recent leading decision of U. S. Supreme Court decision upholding the zoning ordinance of Euclid, Ohio, and the similar later decisions in cases attacking the zoning ordinances of Los Angeles, Calif., and Roanoke, Va., and citing the declaration in the Euclid decision that nothing in it precluded hearing on their merits other cases that might present unreasonable features, the court passing on the University Heights case ruled that the "restriction as affecting the use of intended by the appellee is unreasonable."

In defending its case the main allegations of the village authorities, as summarized in the decision, were: "(1) That the land would be withdrawn from the tax duplicates resulting in a loss of assessed values to the city; (2) that there would be a large number of children attending the local school, which would require additional accounting and inspection by the Board of Education, and might result, notwithstanding the offer of the institution to provide part of the finances for additional school buildings, in an additional outlay for buildings and equipment; and (3) that the public welfare would be affected a school predominantly attended by the children of a single race or creed is hurtful to the community."

New York Subway Board Rejects All Nassau Street Bids

On the grounds that the lowest bidder is not satisfactorily equipped to undertake such a difficult piece of construction, the Board of Transportation of New York City has rejected all the bids for the new Nassau Street subway in the city and will call for new bids.

In giving its reasons for the rejection, the board states that the location of the work to be done under this contract is the most important in the city, judged by the character and volume of the business done and the money invested in buildings, that the $2,500,00 construction of subway in Brooklyn is the largest enterprise that the low bidder has ever assumed and that on that job there are no buildings to underpin and but little traffic to take care of. Consequently, the low bidder has not had experience with the difficult work which must be undertaken in the construction of the Nassau Street line.

Confusion Over New Water Supply for Albany, N. Y.

The hearing on a proposed additional water supply for Albany, N. Y., noted in *Engineering News-Record*, Aug. 11, 1927, p. 243, was on the project set forth in a report by Robert E. Horton, outlined in *Engineering News-Record*, Sept. 23, 1926, p. 520, and not on a plan resulting from a later report by Fuller & McClintock, as the note of Aug. 11 stated. The figures given in the note just mentioned were based on the Fuller & McClintock report. The Horton plan has been approved by the Board of Water Supply and the Board of Estimate of Albany and is now before the New York State Water Power & Control Commission on petition for a permit. The Horton plan includes two large storage reservoirs on Hannacrois Creek and although providing for filtration ultimately, no filtration plant is proposed for the immediate future.

J. C. Bland, Retired Railway Bridge Engineer, Dead

(*Continued from p. 320*)

the Steubenville bridge rebuilding, Mr. Bland began the extension of riveted construction to long spans, which he thereafter steadily extended.

In 1916 the renewal of the Louisville bridge over the Ohio led to still further extension of riveted construction. The old bridge, built by Albert Fink in 1868-1870 was a most remarkable structure, having deck spans of Fink type and two long channel spans of through Whipple type, as described in *Engineering News* of Feb. 8, 1917. (p. 217). The War Department unexpectedly increased its requirements for channel width to such an extent that one of the channels had to be crossed by a span of 640 ft. Riveted construction had been used for the new deck spans, and Mr. Bland applied it also to the channel spans; the 640-ft. span still by far the longest of the type.

Chimney Rock Water Project May be Started Soon

Tentative steps towards the execution of the Chimney Rock project to provide an additional water supply for Newark and Elizabeth, and possibly other communities, have been taken. Council for the North Jersey District Water Supply Commission has been asked to draft contracts between the two cities and also between them and the commission. The project includes a series of storage reservoirs extending westward nearly to the Delaware river, and ultimately, but probably not for some decades, tapping that stream also. Only a small part of the entire project would be started under the proposed Newark-Elizabeth scheme. Pending the completion of the first stage of the project it is expected that Elizabeth would be supplied with water from Newark's allotment in the Wanaque project, which it is hoped will be completed within two years. At present Elizabeth is supplied by a private water company, the distribution system of which it expects to purchase.

Personal Notes

EZRA B. WHITMAN, consulting engineer, Baltimore, Md., has resigned as a member of the Maryland Public Service Commission, to take effect as soon as cases before the commission are heard. Governor Ritchie has appointed STEUART PURCELL to fill the vacancy. Mr. Whitman has held engineering positions in Baltimore since 1906. He was chairman of the Commission on Efficiency and Economy through which all the city's engineering departments were merged into the Department of Public Works. He has been a member of the Public Service Commission of the state since 1921, part of the time as chairman. He was a major in the construction division of the army during the war. Mr. Purcell was for seven years with the Pensylvania R.R.'s construction department on bridge and tunnel work in connection with the Union Station at Washington, D. C. In 1910 he became structural engineer in the building inspector's department at Baltimore. Later he was connected with the city's water department and had charge of construction of the Montibello filtration plant. He was an officer in the Engineering Corps during the war. In 1923 he was appointed chief engineer of Baltimore, after serving as engineer in charge of highways. In 1925, when the engineering departments were reorganized, Bernard L. Crozier was appointed chief engineer and head of the Department of Public Works and Mr. Purcell became head of the Bureau of Highways. Both Mr. Purcell and Mr. Whitman are graduates of Cornell University.

CLARENCE J. DUBY, Youngstown, Ohio, has been appointed chief draftsman of the Trumbull Steel Co., Warren, Ohio. For the past five years he has been in structural steel work and prior to that with the Republic Iron & Steel Co., Youngstown, Ohio, in an engineering capacity; still earlier he was field engineer for the Eastern Steel Co., Pottsville, Pa.

Obituary

BENJAMIN H. DAVIS, New York City, consulting engineer specializing in concrete bridge construction, died Aug. 17 at Saranac Lake, N. Y., after a long illness. Mr. Davis was born in Palmyra, Ohio, in 1883. Following his graduation from Case School of Applied Science at Cleveland, he went to New York as engineer of concrete structures for the Delaware, Lackawanna & Western R.R. The many concrete structures on the Slateford-Hopatcong cutoff, including the Delaware River and Paulin's Kill bridges, of great length, were constructed under his supervision. In 1909 Mr. Davis left the railroad to enter private practice as a consulting engineer and conducted a very successful business as a specialist in large concrete bridges. Among the many, may be mentioned the Schuylkill River bridges at Reading and Conshohocken, Pa., Central bridge over the Merrimack River at Lawrence, Mass., Washington memorial bridge in Wilmington, Del., the Schenectady-Scotia bridge in New York State, and the Tennessee River bridge at Chattanooga, Tenn.

JOHN T. DESMOND, civil engineer, Haverhill, Mass., died at his home in that city Aug. 10. Mr. Desmond was born in Lawrence but his family soon moved to Haverhill where he went to school. He worked several years on the Mississippi River protection work, in the lower stretches and at St. Louis. Returning to Haverhill, for many years he conducted an engineering business, in land surveys and other lines, interrupted by seven years as first city engineer of Haverhill and other periods in municipal work. He also served as a member of the city planning board and board of survey.

ROBERT W. GIBSON, New York City, architect who designed the Albany Cathedral, the New York Botanical Museum, and many business and industrial buildings, died Aug. 17 aged 73 years. Mr. Gibson was born in Essex, England, and educated in England. He came to New York in 1881. He was twice president of the New York Architectural League.

HUGH GLENN, retired contractor, The Dalles, Ore., died Aug. 5 aged 87 years. Mr. Glenn built the railroad between Portland and Astoria, the Spokane, Portland, and Seattle Ry., and many public and business buildings in cities in Oregon and Washington.

BENJAMIN F. BAUDER, civil engineer, Syracuse, N. Y., died Aug. 9 at his home in that city, aged 58 years; he had been retired for several years due to ill health. Besides conducting a general engineering business, Mr. Bauder was formerly a member of the Lake Skaneateles Survey and was connected with engineering work on the South Bay R.R.

HENRY C. ORPEN of Denver, Colo., who has been acting as chief engineer of a boundary survey for the Liberian Government in West Africa, was drowned while bathing at a resort in that country, according to a cablegram recently received in Denver. Mr. Orpen graduated from Washington University at St. Louis in 1906, and after graduation served for several years with the Denver Union Water Co.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Meeting, Boston, Mass., Sept. 13-16, 1927.

AMERICAN WELDING SOCIETY, New York City; Fall Meeting, Detroit, Mich., Sept. 19-23, 1927.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.; Annual meeting, Denver, Colo., Oct. 3-6, 1927.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Fall Meeting, Columbus, Ohio, Oct. 12-14, 1927.

ASSOCIATED GENERAL CONTRACTORS, Washington, D. C.; Fall meeting, Birmingham, Ala., Oct. 17-19, 1927.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Louis, Mo.; Annual Meeting, Dallas, Texas, Nov. 14-18, 1927.

ASPHALT PAVING CONFERENCE: Under the auspices of the Asphalt Association and Association of Asphalt Paving Technologists; annual conference Atlanta, Ga., Nov. 28-Dec. 2, 1927.

HIGHWAY RESEARCH BOARD, NATIONAL RESEARCH COUNCIL, Washington, D. C.; Annual meeting, Washington, D. C., Dec. 1 and 2, 1927.

THE MICHIGAN CONFERENCE ON WATER PURIFICATION will hold its annual meeting in Detroit Oct. 3, 4 and 5. John M. Hepler, of the Michigan State Department of Health, Lansing, is secretary.

THE AMERICAN CHEMICAL SOCIETY'S Division of Industrial and Engineering Chemistry will hold its next meeting at Detroit, Mich., Sept. 5 to 10. A number of papers will discuss chemistry as related to metals. Charles M. Upham will give a paper on "The Chemist's Contribution to Roads."

THE IOWA SECTION of the American Water Works Association will hold its annual meeting, with election of officers, at Council Bluffs, Sept. 28 to 30. It is planned to have exhibits of water-works equipment. One of the features of the meeting will be a discussion of the manual which the Standardization Council of the American Water Works Association is considering revising within the next year.

Construction Equipment and Materials

A Section Devoted to What the Manufacturer Is Doing for the Engineer and Contractor

Data Wanted for Manual on Use of Wood in Construction Work

The National Committee on Wood Utilization, Department of Commerce, Washington, D. C., is preparing to compile a manual on "The Economics of Wood Utilization in Construction." Lack of adequate information on the subjects to be covered is the most important barrier in the way and the committee desires blue prints, specifications and other information and data on any of the subjects covered in the following outline: (1) Practical significance of physical and mechanical properties of woods used in construction; (2) small houses and farm buildings; (3) industrial and miscellaneous buildings; (4) roof trusses and arches; (5) bridges and trestles; (6) wharves and docks. More detailed information concerning the divisions of this outline may be obtained by addressing the committee in Washington.

It is stated that the work will be prepared by a project committee on which the American Institute of Architects, the American Society of Civil Engineers, the Associated General Contractors of America, the National Association of Builders Exchanges, the American Society of Agricultural Engineers, the American Association of State Highway Officials, the American Railway Association and other similar groups will be represented.

Rock Drills Need the Same Care as Does Other Equipment

Care of rock drills because of their rugged construction and efficient operation under extreme working conditions is often given little more thought than is accorded to crowbars. That this is wrong and that their mechanism works better and longer when properly operated and maintained is pointed out in a booklet issued by the Wood Drill Works, Paterson, N. J. See that the drill is properly set up; keep it oiled; keep it clean; tighten the bolts and nuts are some of the admonitions. In more detail they are as follows:

In setting up the drill, see that the legs are set firmly in the rock or if in a muddy place let the leg rest on a common washer or a piece of wood 2 or 3 in. thick. When steam is used, blow out the pipe and hose before coupling to the drill. There is more trouble with new drills from lack of oil than from any other cause. Don't start a drill at full stroke on a slanting rock; chip off the rock until there is a square surface. See that the small port holes in the grooves of the steam cap are not plugged up with dirt. If the valve does not move freely, tap lightly in the center of the chuck, not with an 8 pound sledge. "If you will hit the chuck with a sledge, don't hit it too hard." If there should be a broken pawl spring, take both the spring and pawl out and if necessary, run with only one pawl, but not for any longer time than is absolutely necessary. See that the bolts and nuts are tight; don't wait until they fall into the hole. While a rock drill is supposed to be used roughly and not have much care taken of it, a little care is a good investment.

Concrete Road Yardage

For July the square yardage included in concrete pavement contract awards according to the Portland Cement Association was: 7,298,618 for roads; 4,903,789 for streets; and 412,721 for alleys; or a total for the month of 12,615,128 sq.yd.

The accompanying table summarizes the statistics for the current year:

SQUARE YARDS OF CONCRETE PAVEMENT AWARDED DURING 1927

Month	Roads	Streets	Alleys	Total All Classes
Jan.....	2,656,118	1,504,059	75,352	4,235,529
Feb.....	2,336,031	1,935,262	119,382	4,390,675
March..	5,134,974	3,866,102	298,667	9,299,743
April...	10,264,336	4,931,954	285,924	15,482,214
May....	8,234,755	5,601,627	397,220	14,233,602
June....	8,424,051	6,977,602	673,350	16,075,003
July....	7,298,618	4,903,789	412,721	12,615,128
Totals.	44,348,883	29,720,395	2,262,616	76,331,894

Business Notes

REPUBLIC MOTOR TRUCK CO., INC., Alma, Michigan, has purchased the entire capital stock of the Linn Mfg. Corp., Morris, N. Y., manufacturers of a special type tractor resembling a heavy motor truck except that crawler treads take the place of the rear wheels. The operation of the Linn Mfg. Corp. will be continued at Morris, N. Y., as a division of the Republic Motor Truck Co., Inc. It is said that the Republic Motor Truck Company, Inc., made the purchase as an asset both to its manufacturing and selling organization. The company states that while the "Linn tractor does not replace motor trucks, it will and does operate where it is impossible for motor trucks to go. It combines the flexibility and safety of the truck with the traction advantages of the track-laying type of tractor."

G. H. WILLIAMS CO., Erie, Pa., announces that H. B. Ackland has been appointed manager of the New York territory with offices in New York City. Mr. Ackland succeeds E. L. Sparks, whose personal business has made it necessary to move to the Pacific Coast. It is also announced that C. F. Weiblen has been appointed direct factory representative in the Ohio district with headquarters in Cleveland.

RELAY MOTORS CORP., Wabash, Ind., has acquired the Garford Truck Co., Lima, Ohio. The facilities of this plant, added to those owned by the Relay Motors Corp. in Wabash will provide a capacity of 25,000 of the new Relay trucks a year.

INLAND STEEL CO., Chicago, announces the appointment of Frank R. Meyer, Jr., as assistant vice-president in charge of sheet steel sales to succeed Walter C. Carroll, who resigned Aug. 1 to become president of the National Association of Sheet & Tin Plate Manufacturers. Mr. Meyer was formerly district sales manager, St. Louis, Mo. His successor at St. Louis is Walter F. Brumm. Announcement is also made of the appointment of H. H. Straus as vice-president. Mr. Straus has been in charge of the Chicago Heights, Ill., plant for the past five years.

H. K. PORTER CO., Pittsburgh, announces that because of its constantly expanding locomotive sales volume, George Kirtley has been made western sales manager with offices in the Monadnock Building, Chicago. Mr. Kirtley has been connected with the home office of the company for the past five years.

EARLE GEAR & MACHINE CO., Philadelphia, announces the opening of a New York district office at 92 Liberty St., with C. N. Walsh and George E. Barrett in charge. This office will handle all matters pertaining to the company's products, including cut gears, operating machinery for movable bridges, lock gates, dredges, etc.

WILLIAM H. MAXWELL, JR., formerly representing a group of industrial publications on financial advertising, has discontinued this work and has become associated with Hallgarten & Co., New York City.

JOHN H. CRAWFORD, sales manager of the hoisting machinery department, Clyde Iron Works Sales Co., Duluth, Minn., died on July 27, 1927, age 61 years. Mr. Crawford had been connected with the Clyde Iron Works in various capacities for 26 years and was well known to machinery dealers and owners throughout the country. He had been ill for a period of several months.

RICHARD HARDY, chairman of the board of the Pennsylvania-Dixie Cement Corp., died August 14 from heart disease while in New York City. Until recently Mr. Hardy was mayor of Chattanooga, Tenn. Mr. Hardy was also active in the educational world.

After graduating from the University of Michigan he became superintendent of schools at Escanaba and Ishpeming, Mich., he later sold educational material and textbooks and still later became agency director for the New York Life Insurance Co., at Pittsburgh. In 1907 he helped form the Dixie Portland Cement Co., at Chattanooga, taking the office of secretary. Last year he brought about a merger of the Dixie Portland Cement Co, of which he was vice-president, with other large companies in the east.

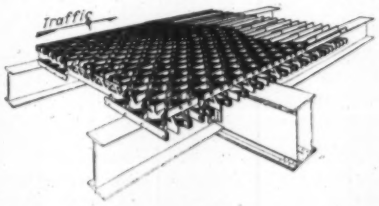
New Developments

Combined Reinforcing and Armor for Bridge Floors

Definitely setting out several years ago to adapt the principle of a steel trussed floor panel to the specific purpose of bridge flooring with the object of reducing floor weight and floor maintenance, engineers of the Irving Iron Works Company, Long Island City, N. Y., have recently developed the "Irving Unified" system of reinforcement and surface armor.

The reinforcement comes in sections. Each section consists of a top and a bottom panel of the company's "subway" grating united by means of shear members into a rigid steel unit. Each section is designed for a specified load and span. Shear members are in the form of Warren trusses. It is said that a method of interlacing and splicing the ends of the bars joins the sections into a continuous steel reinforcement.

The concrete used with this type of reinforcement requires no change in

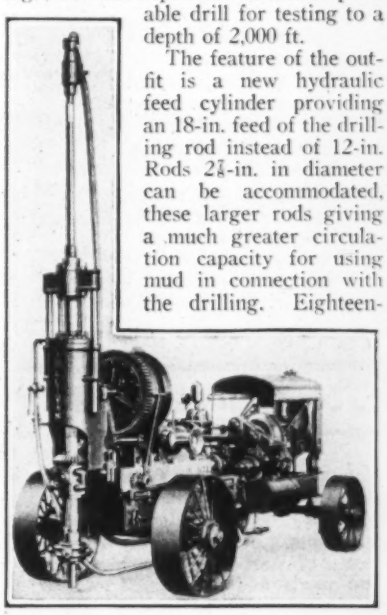


stone size. The reinforcement resting in place on the floor beam is poured full of concrete which is troweled flush with the top edges of the upper steel bars but which extends about ¾ in. below the bottom of the lower bars as a protection to the steel. It is said that a slab 5 in. deep is equivalent in strength to a 7-in. slab of ordinary reinforced concrete, but weighs only 65 lb. per sq.ft. while the ordinary reinforced concrete weighs 85 lb. per sq.ft.

It is felt by the manufacturers that the use of this reinforcing system will effect a considerable saving in truss steel and foundation and will eliminate the cost of much bridge floor maintenance. It is also stated that on all but the smallest bridges a floor of this reinforcement will be the least expensive floor that can be used. Other advantages pointed out are uniformity of reinforcement, ease of transportation and assembly, continuity, ease of making cut-outs for columns, pipes, etc., furnishing of a safe temporary working floor, quick erection, reduction in traffic delays and increase in safety factor.

Mounted Diamond Drill Designed For Deep Structure Testing

In order to meet the requirements of deeper structure testing than is ordinary, the Sullivan Machinery Co., Chicago, has developed the Model N portable drill for testing to a depth of 2,000 ft.

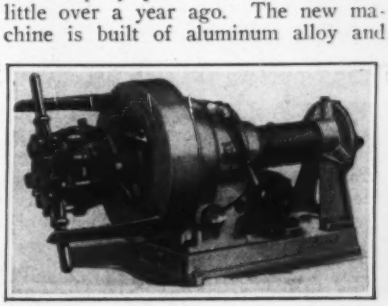


The feature of the outfit is a new hydraulic feed cylinder providing an 18-in. feed of the drilling rod instead of 12-in. Rods 2¾-in. in diameter can be accommodated, these larger rods giving a much greater circulation capacity for using mud in connection with the drilling. Eighteen-inch horizontal travel on the sliding rails of the track is provided, giving ample room for hoisting large casing. Power transmission from the engine to the drill is through transmission gears and clutches. The power plant is a Buda, 30-hp. four-cylinder four-cycle engine.

The design of this machine, especially the hydraulic swivel head is a departure from that which has been standard for years in mineral prospecting. This change has resulted largely from the use of fish-tail bits with mud, which calls for a more rugged machine.

Motor-Operated Pipe Threader Made in 4-In. Size

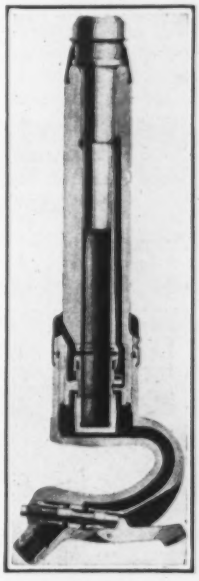
A new 4-in. portable pipe threader has recently been introduced by the Oster Mfg. Co., Cleveland, Ohio, to be known as its No. 414, which will supplement the smaller 2-in. machine which the company placed on the market a little over a year ago. The new machine is built of aluminum alloy and



weighs 380 lb. Driving power is furnished by a ½-hp. Universal motor, operating from 110 or 115-volt lighting circuit, either d.c. or a.c., single phase and of any cycle from 25 to 60. Two-speed transmission is used to supplement the characteristics of a variable speed motor. The machine will handle all sizes of pipe from ⅛ in. to 4 in. and will drive geared die stocks from 4½ to 12 in. by means of an auxiliary drive shaft. The machine is compact, being 24¼ in. high, 47 in. long and 20 in. wide.

Tubular Main Valve Feature of New Riveting Hammer

A new riveting hammer has recently been developed by the Cleveland Pneumatic Tool Co., Cleveland, Ohio, the chief feature of which is the tubular main valve through which the piston passes at each stroke. The valve allows live air to move the piston in both directions. The valve is short, light in weight and has solid walls free from port holes and is reinforced at the lower end as a protection against injury from piston slap. Pistons of varying lengths may be used. An air reservoir is provided between the outer walls of the valve block and the inner bore of the handle termed the "power pocket" in which air is stored up and discharged on the piston at the beginning of each stroke giving added impulse to the piston and increasing its speed and the force of its blow. A new design of safety lock for the handle is used. The balanced throttle valve is controlled by a throttle lever which is allowed a reasonably free action before it opens the valve. It is claimed that the new riveter is a specially well balanced hammer free from vibration.

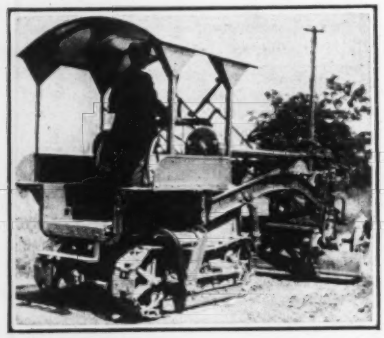


A New Motor Grader

A new motor grader combining the Galion E-Z motor grader with the Cletrac tractor, model K-20, has recently been announced by the Galion Iron Works & Mfg. Co., Galion, Ohio. Especially important in connection with the unit is the ease of attachment in which loosening four bolts and hoisting the rear of the grader makes the tractor immediately available for other service. The features of the motor grader include a scarifier, a new type of spring suspended yoke, a low platform with fenders and a cab. Steering, scarifier control, and blade lift are all by machine

cut worm gearing operating in a bath of oil.

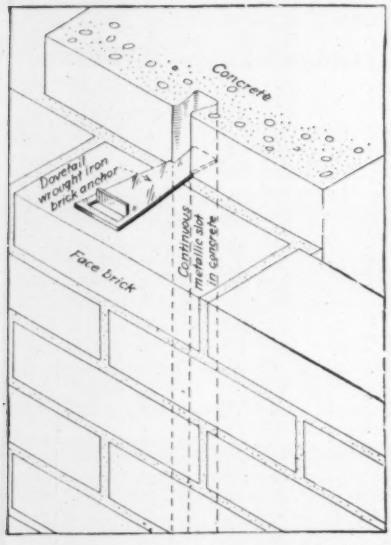
Another feature of the combination is the compensating differential and planetary transmission of the tractor, which causes it to follow the front wheels of



the grader as steered by the operator. At the same time the steering mechanism of the tractor is instantly available in difficult situations, thus giving the operator an extra factor of control when needed.

Steel Anchor for Masonry and Brick Facing

An anchor of No. 22 gage galvanized steel known as a dovetail slot has recently been used on a number of im-



portant buildings and is manufactured by the Dovetail Anchor Slot Co., 149 West Ohio St., Chicago. As shown in the accompanying illustration, the slot comes in standard 10-ft. lengths, is 1 in. wide, tapering to $\frac{5}{8}$ in. at the mouth. It is nailed to the inside face of the exterior column and spandrel forms. The dovetail locks into the slot at any height. Different types are made for carrying anchor rods for holding brick, terra cotta and masonry. No accurate measuring or laying out of course heights is required. There are no holes in the formwork to be bored and no wires to be installed. Neither is drilling of the concrete necessary.

Manufacturers and Trade Associations

Calendar

Annual Meetings

NATIONAL HARDWOOD LUMBER ASSOCIATION, Chicago; Annual Convention, Chicago, Sept. 15-16.

CONCRETE REINFORCING STEEL INSTITUTE, Chicago; Semi-annual meeting, Aviation Country Club, Detroit, Sept. 19-21.

AMERICAN PAINT & VARNISH MANUFACTURERS ASSOCIATION, Philadelphia; Annual Convention, Atlantic City, Oct. 24-25.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, New York; Annual convention, Pinehurst, N. C., Oct. 25-29.

NATIONAL ASSOCIATION OF MANUFACTURERS; Annual meeting, Chattanooga, Tenn., October 25, 26 and 27.

New Publications

Silicate of Soda for Concrete Roads—GRASSELLI CHEMICAL CO., Cleveland, Ohio, has just published a 22 page booklet treating quite extensively the use of silicate of soda in the curing of concrete roads and streets. The booklet explains the method used in applying the company's silicate of soda to pavements, and treats in considerable detail the advantages of its use from the point of view of efficiency, simplicity and economy. The results of a number of tests are given and also the statements of city officials as to their experiences with its use. The booklet is illustrated with important work upon which the company's product has been used.

Diesel Engines—BETHLEHEM STEEL CO. Bethlehem, Pa., in its catalog F, describes its Type S Diesel engines for stationary service. Cross-sections and illustrations of machine details aided by the descriptive text give a clear picture of the materials that go into the machines and of the method of their operation.

Flanged Leg Channel Sections—SWEET'S STEEL CO., Williamsport, Pa., in its pamphlet No. 1 describes and illustrates fence and sign posts utilizing its flanged leg channel sections. These sections are also suitable for telegraph pole crossarms, roofing skylights, etc.

Welded Roof Truss Tests — LINDE AIR PRODUCTS CO., New York City, has published in booklet form a complete summary of its studies and the tests which it made at its Buffalo plant on a series of oxyacetylene welded roof trusses and in which comparisons were made with a riveted truss and with a welded tubular truss. The booklet describes the new insert plate joint developed from these tests and by the use of tables, illustrations, drawings and text makes available the results that were determined. The booklet was written by H. H. Moss, development section engineering department of the company, who was in charge of the testing work.

Power Shovels — MARION STEAM SHOVEL CO., Marion, Ohio, has recently issued three new bulletins as follows: Bulletin 318 illustrating and describing its type 7 steam machine; Bulletin 319 illustrating its type 7 gas-electric machine, and Bulletin No. 320 illustrating its type 7 straight-gas machine. Each of the bulletins contains illustrations of the machines' details and blueprints and specification tables of the machines equipped as shovels, cranes or draglines.

Copper-Bearing Steel—TRUSCON STEEL CO., Youngstown, Ohio, has made available a new booklet No. 679, entitled "Copper-Bearing Steel Resists Corrosion." It has been compiled by Robert D. Snodgrass, consulting engineer, and consists of a description of the results found in a number of important tests made on copper-bearing steel in the last 10 years. The conclusions stated are as follows: (1) 0.25 per cent of copper in steel is sufficient to resist corrosion under ordinary atmospheric conditions; (2) we recommend the use of paint on copper-bearing steel; (3) we do not recommend galvanizing copper-bearing steel.

Pyrometer Instruction—BRISTOL CO., Waterbury, Conn., has published, in its Bulletin No. 358, complete information on the installation and use of pyrometer equipment. The bulletin contains 36 pp., divided into paragraphs, which are indexed for handy reference. Besides installation and use data, the catalog features causes and remedies of pyrometer troubles.

Water Control Apparatus—RODNEY HUNT MACHINE CO., Orange, Mass., has prepared a comprehensive loose leaf catalog of 122 pages, illustrating and describing its water controlling apparatus for power plants, water reservoirs, irrigation projects, filtration and sewerage plants. Photograph and blue print illustrations and text describe the apparatus, while there are included also a number of important hydraulic tables and graphs. Some of the equipment described includes floor stands, rack and pinion gate hoists, tainter gate hoists using chain and cable, and gates.

Jacks—BLACKHAWK MFG. CO., Milwaukee, Wis., has published a catalog illustrating and describing its complete line of hydraulic oil-power jacks. Jacks for cars, trucks and motor coaches, both low and high lift, and for industrial and construction uses up to 75 tons capacity are described.

Rail Crane—PARSONS CO., Newton, Iowa, has issued an 8-p. pamphlet describing its crane for handling rails, ties, etc., and for operating pneumatic and electric tools.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Cost Data for an Ohio Club Built in 1925

UNIT costs on a five story and basement club building, Richards, McCarthy & Bulford, architects, Columbus, O., valued at $502,449, are given herewith. Extras were 1.5 per cent of total cost, and by excluding special footings and underpinning, these could have been reduced to 0.18 per cent of the total. Cubic contents were 1,315,400 cu.ft. at a rate, including architects' fee, of 38.2c. per cu.ft.

Contract was let January 16, 1925, and the building completed in February, 1926. A pocket of quicksand, under one corner of the building, was struck during the excavation, requiring the driving of considerable sheet piling, the underpinning of the wall of an adjacent building, and considerable additional plain concrete, in the footings in this section of the building. The total cost of this extra work is included under the extras, in connection with plain concrete in the cost schedule.

A brief description of the building, follows: Five stories and basement, containing swimming pool, bowling alleys, large assembly hall, gymnasium, lounging rooms, billiard room, and seventy-five bedrooms; Steel frame, fireproofed with concrete; reinforced concrete floors; exterior—brick trimmed with terra cotta, wood sash; wood trim, wood floors in gymnasium and assembly room; cement floors with wood base in bedrooms; mastic floors with terrazzo base in corridors; mastic floor in one-half of basement; terrazzo base and rubber tile floors in one-half of first floor (rubber tile not included in contract); ornamental iron and marble stairway grade to second floor; other sairways pressed steel with mastic treads; one elevator; shower rooms—tile floors and wainscoating; toilet rooms—tile floors, marble wainscoating, marble shower and closet stalls; low pressure steam heat; exhaust ventilation, except to gymnasium, bowling alleys, and swimming pool, which have a plenum system; bowling alleys not included in this contract. Costs schedule follows:

		Extras	††
General Contract—			
Excavation	4,659.00		1.
Plain concrete	22,004.00	$6,279.42*	4.7
Reinforced concrete	47,023.14		10.
Cement finish	4,373.24		.9
Face brick & T. C.	40,226.00		8.5
Common brick and tile	37,095.00		7.8
Stone work	6,322.00	85.00	1.3
Waterproofing	1,167.00		.3
Steel	56,446.01		12.
Lathing	7,418.00		1.6
Plastering	19,062.20		4.1
Painting and Glazing	8,047.70		1.7
Roofing	2,940.00	30.00	.6
Ornamental iron	15,750.00		3.3
Marble, tile and terrazzo	24,071.25		5.1
Mastic floors	1,575.00		3.
Metal partitions	359.10		1.
Carpentry	10,005.13		2.1
Millwork	38,131.00		8.1
Hardware	6,604.23		1.4
Other Expense	$9,721.00		2.1
	$363,000.00	$6,394.42	77.0

* Extra cost caused by quicksand

Plumbing, Heating and Ventilating—			
Sewers	1,850.00		
Drainage systems	10,140.00		
Water supply	4,450.00		
Ice water systems	2,225.00†		8.8
Fixtures	6,000.00		
Bryant heaters	950.00		
Circulating pump and motors	350.00		
Filters	2,400.00		
Gas	200.00		
Heating boilers	7,388.00		
Pump and motors	1,500.00		
Hot water tank and heaters	900.00		
Sheet metal work	2,500.00		
Fan and air washer	5,000.00		
Radiation	5,460.00†		8.3
Temperature Reg.	1,600.00		
Pipe and fittings	24,976.50		
Vacuum equipment, old building		$441.00	
Other Expenses	$1,210.50		
	$80,700.00	$441.00	17.1

† Other Expense and Pipe and Fittings split equally between Plumbing and Heating.

†† Per Cent of Total Cost (Extras Not Included)

				††
Electrical Work—				
Labor	$3,422.25			
Conduit	2,100.00			
Conduit fittings	1,044.44			
Panels and cabinets	585.55			
Switchboard	611.11			
Wire	577.77			
Wire fittings	285.44			
Bond	164.44			
Inspection	50.00			
Additional outlets		$121.00		
	$8,841.00	$121.00		1.9
Miscellaneous—				
Lighting fixtures	6,240.00			
Elevator	5,150.00			
Chlorimeter	600.00			
Extra sewer		$189.00		
	$12,170.00	$189.00		2.5
Decoration (Bid-contract not let)	7,000.00			1.5
Total	$471,711.00	$7,145.42		100.00
		6,279.42*		
		$866.00		
Total cost	$471,711.00			
Extras	7,145.42			
	$478,856.42			
Architects fee 5% of $471,856.42	23,592.82			
Grand total	$502,449.24			

* Extra cost caused by quicksand

Extras, 1.5 per cent of total cost.

Extras, exclusive of special footings and underpinnings, 0.18 per cent of total cost.

Total contents, 1,315,400 cu.ft.; cost per cu.ft., $0.364.

Cost per cu.ft. including architects' fee, $0.382.

††Per Cent of Total Cost (Extras Not Included)

READY SOON!

Itemized costs on an Ohio loft building completed in March, 1927.

$5,000 per mi. of 8-in. oil pipe line in Texas, laid by forces of the Prairie Pipe Line Co.

$38.40 per ton for 8-to 16-in. Class C c.i. pipe, and $73 per ton for special castings.

32,311,802 cotton spindles were active during July, compared with 31,057,484 in July, 1927.

Weighted food index for July, 1927, as computed by the Bureau of Labor Statistics, is 153.4, compared with 158.4 in June and 160.6 for the 1926 average.

Bank clearings in the week of Aug. 18 exceed those of a year ago by 14.1 per cent. The increase is mainly in New York and in other large centers.

Freight loadings for the week ended Aug. 6 totaled 1,024,218 cars, compared with 1,075,392 one year ago and 1,052,518 in the corresponding week of 1925.

Automobile production in first seven months of 1926 and 1927:

Trucks	272,847	278,574
Passenger	2,387,424	2,012,103
Total	2,660,271	2,290,677

Architectural terra cotta was produced to the amount of 85,113 net tons, worth $8,688,140, in the first seven months of 1927, compared with 99,523 tons, worth $16,622,563, in that period of 1926.

Earning capacity of unskilled labor is treated in the *Monthly Labor Review* for August. Average earnings of railway track laborers in 1926 were $17 a week, and in the lumber industry in 1925 the average was $17.77.

Production of pig iron and ferroalloys in the United States in the first half of 1927 is presented by the American Iron and Steel Institute in its special statistical bulletin No. 4. The total for pig iron is 19,202,070 gross tons, compared with 19,679,737 in the first half of 1926.

Seattle reports better business by road equipment dealers in Puget Sound district, as road work in state proceeds rapidly. Proposals are being taken for four projects, openings on Sept. 13. State is calling for bids for 50,000 gal. of oil for unpaved roads. Indications of unemployment this winter.

This Week's Contracts—With Comparisons

Minimum costs observed are: $15,000 for water-works and excavation, drainage, irrigation, levee, river and harbor projects; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial, educational, institutional, religious and other buildings.

Week ended	Public Work	Private Work	Total Contracts
August 25, 1927....	$27,764,000	$39,225,000	$66,989,000
August 18, 1927....	29,536,000	25,441,000	54,977,000
August 26, 1926....	15,184,000	26,549,000	41,733,000
Jan. 1 to date			
1927	784,340,000	1,179,387,000	1,963,727,000
1926	739,274,000	1,162,848,000	1,902,122,000

E.N.-R. Index Numbers On August 1, 1927

COST	VOLUME
205.50	252

The Index Numbers are published in detail and with charts in the first issue of each month. The Cost Index is given in full from 1903 through 1926, with a thorough explanation of its method of computation, and a graphic comparison with many other index numbers, in the 48-page pamphlet entitled Engineering News-Record Construction Costs.

Weekly Construction Market

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, per 100 lb....	$3.34	$3.80	$4.00	$3.10	$3.35	$3.87½	$3.10	$3.00	$4.00
Structural rivets, per 100 lb.....	5.00	3.80	4.75	3.50	3.75	4.64	5.00	5.25	5.50
Reinforcing bars, per 100 lb.....	3.24	2.80	2.75	2.15@2.50	2.87½	3.77½	2.95	3.00	3.57
Steel pipe, black, 2½ to 6 in., lap weld, discount from list	48%	54%	54%	51%	48%	41%	.42@53.8%	48%	.....
Cast-iron pipe, 6 in. and over, per net ton	44.60	40.00	54.00	42.20	46.50	56.50	43.00	55.00	41.00
Concreting Material									
Cement, without bags, per bbl. .	2.35†	2.40	2.05	2.05	2.22	2.85	2.51	2.65	—1.42
Gravel, ¾ in., per cu.yd.....	1.75	2.20*	2.38	2.00	1.65	1.90	1.80	1.25	1.90*
Sand, per cu.yd.	1.00	1.40*	2.00	2.00	1.25	1.00	1.40	1.25	1.35*
Crushed stone, ¾ in., per cu.yd...	1.85	2.50*	2.83	2.00	1.75	2.50	1.70	3.00	2.00*
Miscellaneous									
Fir, 3x12 to 12x12, 20 ft. and under, per M.ft. b.m.	.....	.....	.....	39.00	38.75@39.75	34.25	27.00	24.50	55.00
Pine, 3x12 to 12x12, 20 ft. and under, per M.ft. b.m.....	62.00†	34.00	56.00†	.....	.....	.....	.....	.....	.....
Lime, finishing, hydrated, ton...	—17.45	24.50	19.00	20.00	25.50	24.00	27.50	24.00	21.00
Lime, common, lump, per bbl ..	2.10@3.00‡	1.35	1.82	1.50	1.70	2.70‡	1.70	2.80‡	10.00*
Common brick, per M	17.00†	12.50	13.60	12.00	13.75†	8@12	14.00	14.00	20.25
Hollow building tile, 4x12x12, per block	Not used	.0724	.103	.....	.072	.085	.....	.10	.10
Hollow partition tile, 4x12x12, per block	.1027	.0724	.103	.076	.072	.085	.108	.09	.08
Linseed oil, raw, 5 bbl. lots, per 7½-lb. gal.	—.84¾	—.91	1.10	.83½		1.04	.92	.98	1.03
Common Labor									
Common labor, union, per hour.	.90⅝	.30	.....	.90	.....	.....	.60	.70	.....
Common labor, non-union, hour.	.....	.25	.30@.50	.82½	.45@.60	.31½@.50	.50	.62½	.30@.35

*Ton. †Delivered. ‡280-lb. net. +Advance. —Decline.

THE industrial employment survey of the United States Department of Labor, for July, reveals some idleness throughout the country. Several of the major industries curtailed their forces as well as their operating schedules. This was largely due to the usual midsummer slackening in industry, which is more evident in July because that month is generally selected for plant alteration and repair work and inventory taking, necessitating the release of many workers for a short time. This is also the season for vacations, when a great many men and women are away from their various occupations.

A decided improvement in the boot and shoe industry was reported in the New England district. Many of these factories that have been operating on part-time schedules for some time past returned to full-time operations, and in localities where part time continued, the forces employed were increased. There was a further recession in the automobile industry and a large number of these workers were unemployed during the month. In the iron and steel centers of the country the volume of employment decreased, largely due to seasonal influences. In the textile industry there was very change. Many mills continued part-time operations, and in some localities a surplus of this class of labor exists. Railroad-shop employment decreased during the present month.

There was a marked decline in building and a surplus of building-trades men is apparent. Municipal improvements and road construction are affording employment to a large number of unskilled workers. The demand for farm labor increased, particularly in the wheat belt, where the harvest demand has been seasonally heavy, but in most localities there was sufficient help available.

THIS limited price list is published Weekly except in the first issue of each month and gives current prices on the principal construction materials in the chief cities. Valuable suggestions on costs of work can be had by noting actual biddings as reported in the Construction News and Unit Prices sections following.

The first issue of each month carries complete quotations for all of the basic materials and for the rest of the important cities, also wage rates for the principal building trades and common labor. The last complete list will be found in the issue of Aug. 4, the next on Sept. 1. Explanation of prices contained in the table will appear from time to time in this section; last shown Aug. 11, 1927, p. 247.

UNIT PRICES

For actual prices bid on materials in place at various construction jobs throughout the country see pp. 104-104a of this issue, following Construction News